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ENVIRONMENTAL HAZARDS ELEMENT

MARIN COUNTY PLANNING DEPARTMENT
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EXECUTIVE SUMMARY

The Marin Countywide Plan Environmental Hazards Element has been updated to reflect the most recent legislation and information regarding environmental hazards. The following hazards have been addressed: Geologic, Seismic, Floods and Fire.

Geologic hazards such as landslides, debris flow, liquefaction, and differential settlement exist throughout Marin County. All of these conditions would be accentuated in the event of an earthquake. Marin County has only one active fault, the San Andreas Fault, which passes through West Marin. Seismic activity on the San Andreas fault poses a threat to lives and property and may trigger flooding and fire as well as landslides or other geologic events.

Even in the absence of an earthquake, geologic hazards, fire and flooding are a major concern. Through zoning, project review procedures, public information, and coordination with other agencies, impacts from these environmental hazards can be reduced to a minimum.

The objectives, policies and programs contained in this Element are aimed at reducing death, injuries, damage to property and the economic and social dislocation resulting from environmental hazards.

I. BACKGROUND

The Environmental Hazards Element was adopted by the Board of Supervisors in 1977. Many of the policies were successfully carried out. The 1988/89 update includes current information and regulations. The Element is the vehicle for identifying potential hazards which need to be taken into consideration when making land use decisions and contains policies, objectives, and programs designed to minimize the effect of potentially hazardous conditions. The Element addresses geologic hazards, fire hazards, flood hazards, and seismic safety.

The Element fulfills the requirements for a "Safety Element" as described in the California Government Code Section 65302(g). The Code states that the general plan shall include:

A safety element for the protection of the community from any unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, and dam failure; slope instability leading to mudslides and landslides, subsidence and other geologic hazards known to the legislative body; flooding; and wildland and urban fires. It shall also address evacuation routes, peakload water supply requirements, and minimum road widths and clearances around structures, as those items relate to identified fire and geologic hazards.

II. EXISTING CONDITIONS

Marin County is characterized by a diversity of natural and man-made features which present a wide range of environmental hazards. Steep slopes underlain with unstable soils create landslide risks; low-lying areas are susceptible to floods; dam inundation areas cover many square miles; and the San Andreas fault passes through West Marin.

Disaster response. Many agencies exist whose actions help to mitigate the effects of a disaster. These include the County Office of Emergency Services, Public Works Department, Planning Department, and Fire Protection Districts. In order to effectively respond in the event of an emergency situation, the Office of Emergency Services is preparing the Marin County Multihazard Plan. The first of three sections was completed and approved in September 1986. The Multihazard plan focuses on the response to large-scale disasters. In contrast, the Countywide Plan focuses on minimizing the impact of an emergency situation through the implementation of policies and programs.

The Multihazard Plan outlines actions for officials in the event of a major disaster including establishment of command posts, evacuations, traffic control, transportation supplies and equipment, requests for mutual aid, public information including evacuation instructions and media announcements, and provisions for return home travel.

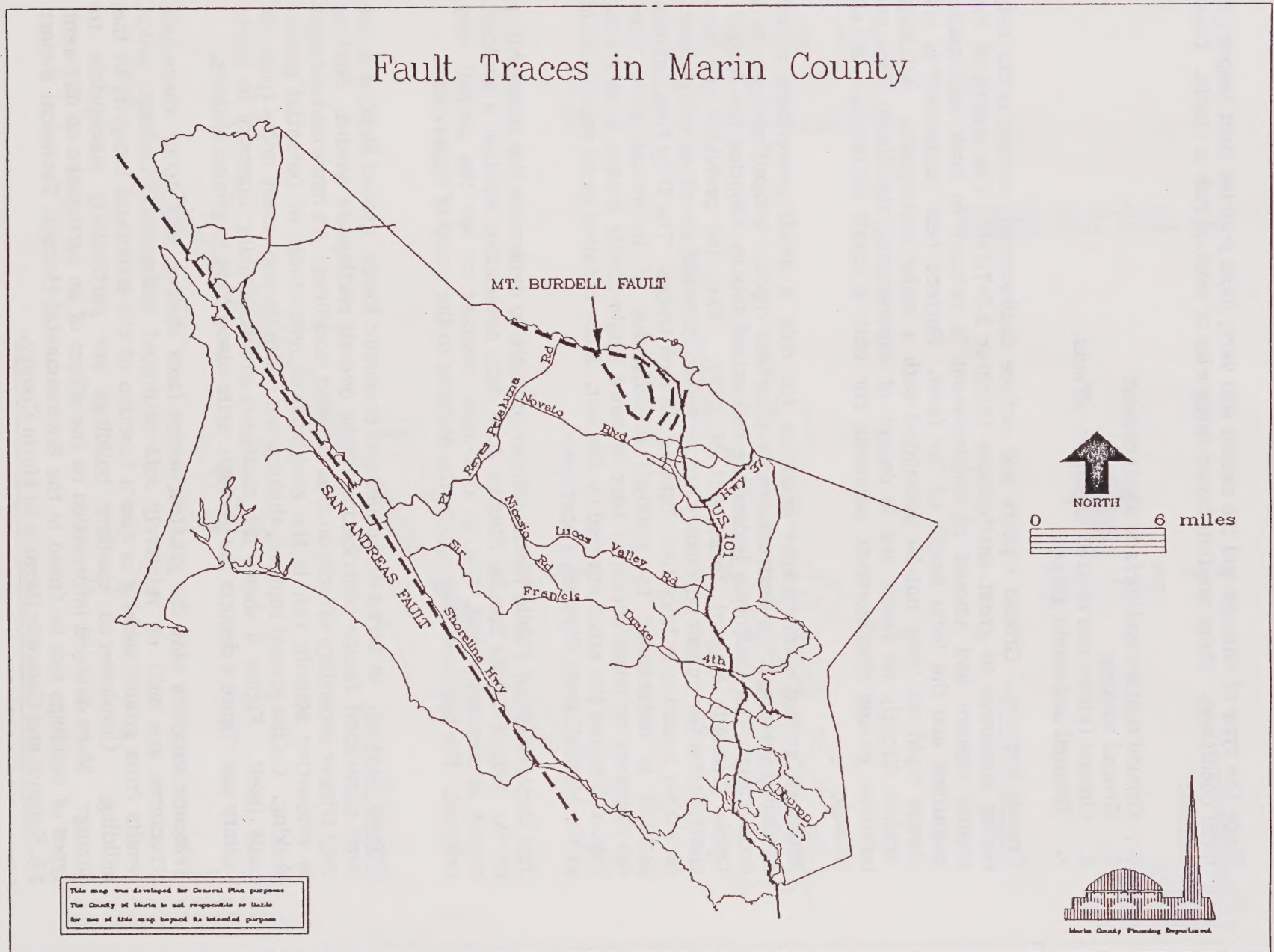
A. SEISMIC HAZARDS

The San Andreas Fault runs through the western portion of Marin County (see Figure 1). It is the only known active fault in the County although some geologic evidence exists that there has been movement within the past 10,000 years on the only other local fault zone: Burdell Mountain. The epicenter of the famous 1906 earthquake with a magnitude estimated at 8.25 on the Richter scale was in the vicinity of Olema in West Marin. Along the fault zone in West Marin, where settlement and buildings were either concentrated, multi-storied, or located on alluvium, damage was severe and ground displacements of 21 feet were reported near the head of Tomales Bay.

Earthquake Damage

The effect of an earthquake can vary from mild to severe and the amount of damage will be dependent on the location of the epicenter, the geology of the area, the amount and type of development, as well as the magnitude of the quake.

Figure 1 - Fault Traces in Marin County



Since the type of damage and the extent will vary, local policies must respond to local conditions. There are four broad categories of seismic risk in Marin. These include:

1. Ground rupture and surface displacement
2. Ground shaking
3. Ground failure and related secondary effects.
4. Tsunami and seiche effects

Ground Rupture. Ground rupture and surface displacement usually occur only during moderate to great earthquakes (Richter 5.3-7.7+). The length of the ground rupture and amount of displacement is related to both earthquake magnitude and the total length of the fault. Surface fault movement is not always rapid and may not be associated with a major earthquake. Buildings located directly on faults are in danger of experiencing significant damage; however ground displacement accounts for only a small percentage of all damage.

Although ground displacement accounts for only a small percentage of all earthquake damage, the destructiveness of surface rupture is significant where it does occur. The California legislature recognized this by adopting the Alquist-Priolo Geologic Hazard Zones Act of 1972. The Act prohibits any new construction for human occupancy across known traces of specified active faults or within a minimum fifty foot distance of such traces. The fifty foot building setback is determined by geologic investigation of individual sites when development or construction of four or more single-family houses is proposed. Figure 2 shows the areas covered by the Act. More detailed maps are available at the Marin County Planning Department.

The Department of Public Works reviews projects to determine the applicability of the Alquist-Priolo Special Studies Zone Act, determines whether a geologic report is necessary and, finally, concludes whether or not the project may proceed. The applicant may appeal the decision to the Board of Supervisors.

Ground Shaking. In terms of human and economic losses, ground shaking is the most significant factor contributing to the overall earthquake hazard. Shaking may trigger secondary effects such as fire and landslides. An important element in evaluating seismic risk is the geographical assessment of potential ground shaking. Unlike ground rupture, shaking can cause damage many miles from the fault itself. Figure 3 shows the maximum ground shaking intensity in Marin County and Figure 4 depicts the geologic units susceptible to ground shaking.

Evidence suggests that the greatest losses from shaking may occur where tall structures are built on relatively soft saturated sediments. Damage which results from ground shaking is also a function of the structural integrity of the building. Unreinforced masonry buildings are particularly susceptible to damage. More detailed information on the effect of an earthquake on different types of buildings can be found in the Environmental Hazards Technical Report #3, Seismic and Geologic Hazards in Marin County.

Figure 2 - Areas Covered by Alquist-Priolo Special Studies Zone Requirements

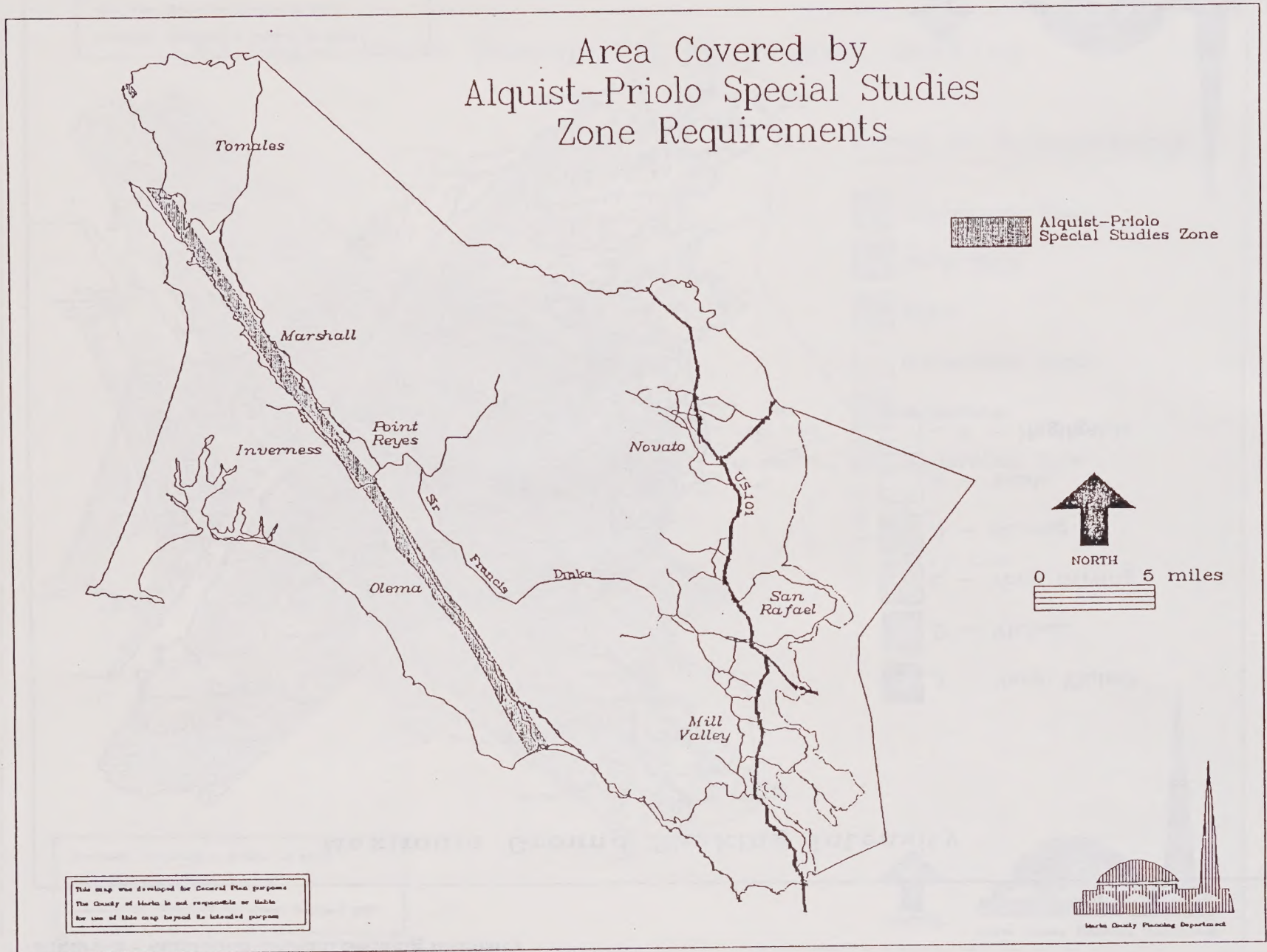


Figure 3 - Maximum Ground Shaking Intensity

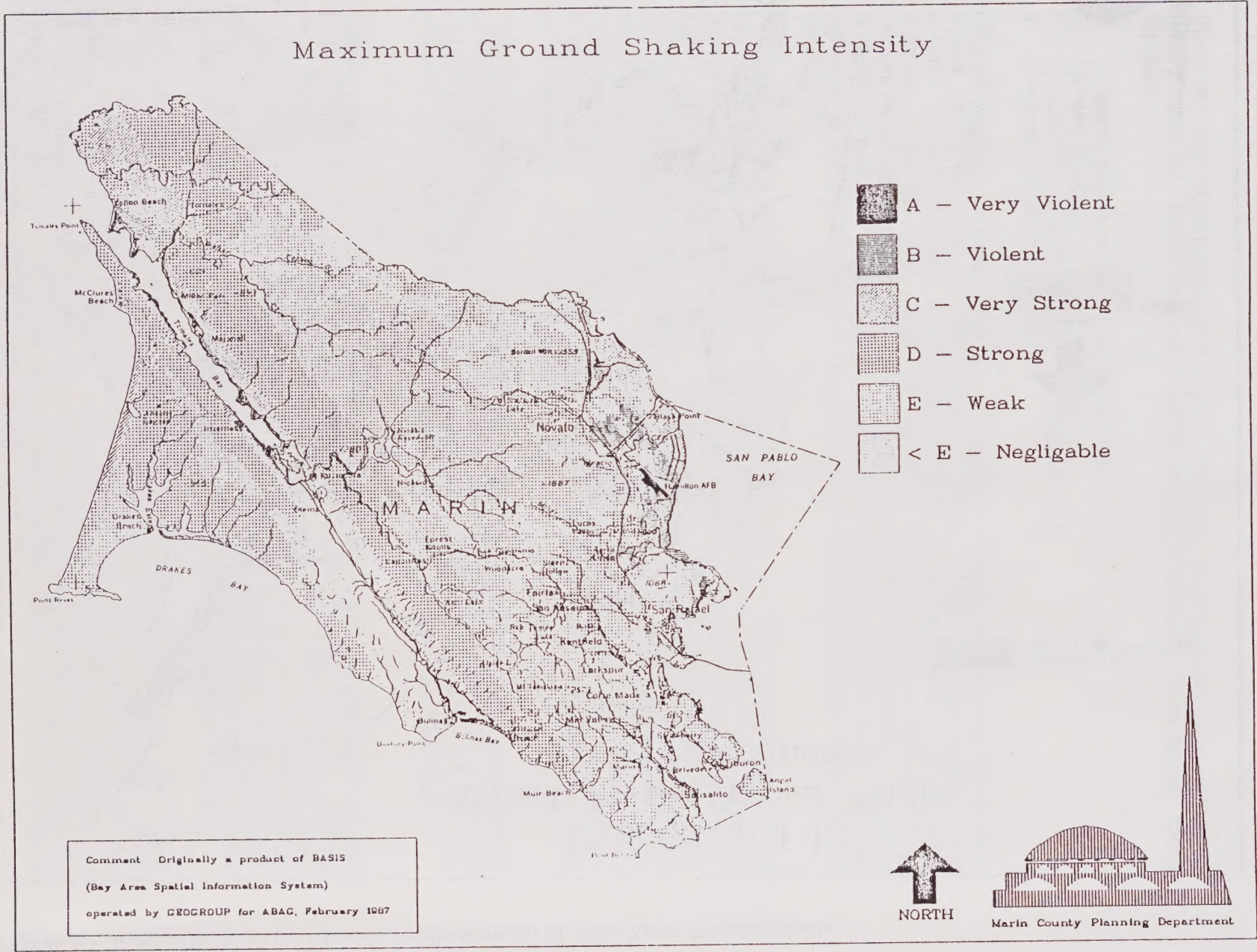
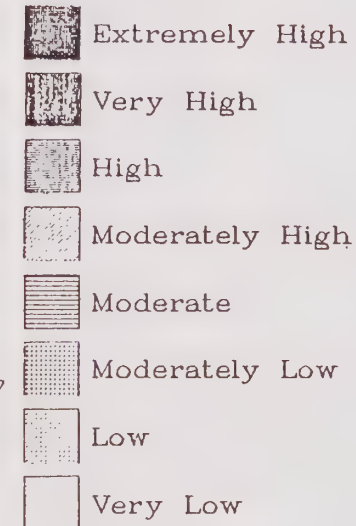


Figure 4- Geologic Units Susceptible to Ground Shaking

Geologic Units Susceptible to Ground Shaking

Level of Susceptibility:



Comment Originally a product of BASIS
(Bay Area Spatial Information System)
operated by GEOGROUP for ABAG, February 1987



Marin County Planning Department

It is anticipated that the secondary effects from ground shaking will cause the most damage from an earthquake in Marin. Many streets traverse known landslide deposits, and streets are the usual routes of underground utility lines. A landslide could rupture water, gas and sewer lines and block transportation routes. In addition, ground shaking could cause highway overpasses to collapse, further crippling transportation routes. There may also be damage to dams and levees, causing a potential for flooding. A large enough earthquake could completely rupture dams, releasing most of the retained reservoir waters.

Ground Failure. Ground failure includes liquefaction, lateral spreading, landsliding, and differential settlement. Landslides and differential settlement may occur independent of a seismic event and are discussed in the Geologic Hazards section (see p. 11 of this Element. Liquefaction occurs when an earthquake transforms saturated, loose granular materials (silt, sand, or gravel) into a fluidlike state in which the solid particles are in suspension, similar to quicksand. Clay is an important deterrent to liquefaction since the clay tends to bind the sand together. Water saturated deposits are the most prone to liquefaction. In Marin, the liquefaction-prone geologic materials, in order of decreasing susceptibility, are artificial fill, sand and alluvium. The areas in Marin County most susceptible to liquefaction are shown in Figure 5.

Lateral spreading is another type of ground failure which can be induced by an earthquake. Lateral spreading occurs when there is a loss of strength in fine-grained cohesive materials, most often occurring in soft, saturated clays such as bay mud. Both liquefaction and lateral spreading may weaken foundations and render bridges unsafe and overpasses unusable.

Earthquake-induced landslides will occur generally in the same marginally stable areas as landslides induced by other factors, and may be indistinguishable from them in appearance. The addition of earthquake energy may induce landslides that otherwise might not have occurred until a future rainy season, or other precipitating event. Landslides in areas of low slope angles can result from liquefaction of subsurface sand layers during earthquakes.

Tsunami/Seiche. A tsunami is a large ocean wave usually generated by a seismic event in or near the ocean. Coastal floods from tsunami occur rarely along the Pacific Coast or in the San Francisco Bay. The most recent tsunami to cause any significant damage was in 1964 (a result of an earthquake in Alaska). The 1964 tsunami caused roughly \$275,000 in damage to yacht harbors in San Rafael and Sausalito along the Bay.

A seiche is an earthquake-generated wave in an enclosed body of water, such as a lake or a reservoir. Seiche waves are generally small (less than a foot), but in shallow or constricted areas, wave run-up can be as great as 20 or 30 feet, overtopping dams and reservoirs and flooding downstream development. These events are discussed in more detail in Environmental Hazards Technical Report #1, Floods: Existing Conditions and Recent Studies.

Environmental Hazards Element, Draft,
March 1989, KAFI,



Legislation and Regulations

It is crucial that special consideration be given to the location of critical facilities. Critical facilities are those facilities that must remain operational after an earthquake for a community to respond effectively. Examples of critical facilities include hospitals, fire stations, and communication facilities. The Essential Services Buildings Seismic Safety Act of 1986 (Health and Safety Code Section 16000 et seq.) regulates design and construction of new facilities; however, local regulations are necessary for specific locational criteria. Local regulations also govern the safety of existing critical facilities. Communities should assess the vulnerability of existing critical facilities in order to ensure that emergency operations can be carried out effectively.

The Alquist-Priolo Special Studies Zone Act addresses potential ground rupture hazards and is discussed on p. 4.

SB 547 (Government Code 8876) is directed at reducing hazards in existing buildings. Inventories of all unreinforced masonry buildings, and mitigation measures must be developed by 1990. The unincorporated portion of Marin County only has one unreinforced masonry building. It is located in Point Reyes Station.

In addition to the legislation discussed above, the Uniform Building Code contains standards for construction which specifically relate to earthquakes and the Field Act contains rigorous specifications for construction of all public school buildings. Technical Report #3, Seismic and Geologic Hazards in Marin County contains detailed information on the effects of earthquakes on different types of buildings.

B. GEOLOGIC HAZARDS

Marin County has two types of geologic conditions which contribute to stability problems, even in the absence of a seismic event. First, the County is characterized by steep hills and ridges which are subject to landslides and downhill creep. Secondly, the bay plains, marshlands and mud flats are subject to subsidence and differential settlement.

Landslides

Landslides occur in certain areas for specific and relatively predictable reasons. The conditions which affect slope stability are:

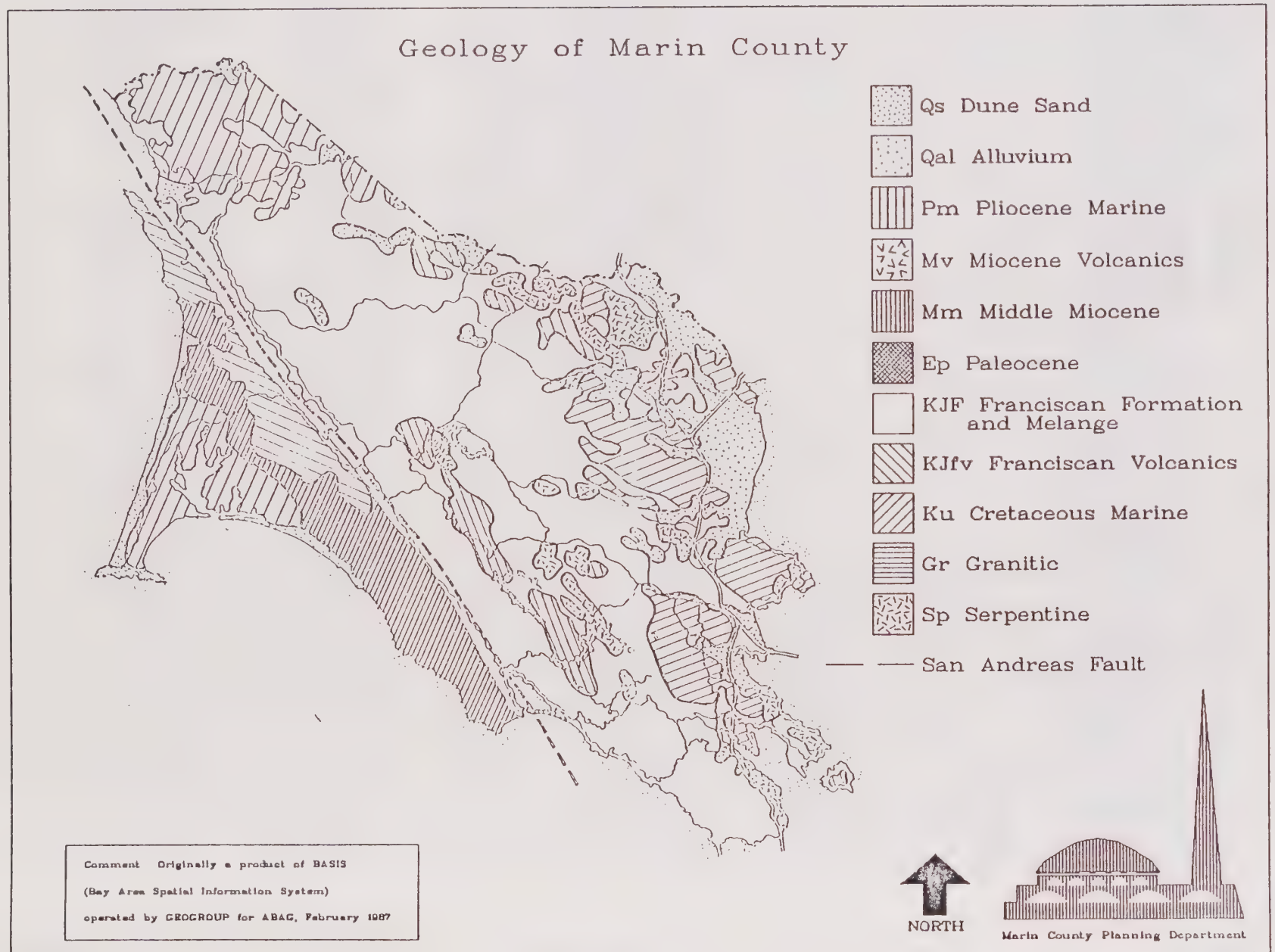
1. The steepness of the slope,
2. Characteristics of the soil,
3. Degree of saturation,
4. Human activities.
5. Seismic activity.

Steep slopes are not inherently unstable. However, a steep stable slope may be rendered unstable by cuts made for roads, homes, or other development. The characteristics of the soil also affect slope stability. Much of Marin County is underlain by Franciscan melange (see Figure 6). These soils are highly expansive, and rich in clay. Moderately steep slopes underlain by such material often exhibit evidence of slow downhill creep or debris flow landslides. Soil saturation may occur during periods of heavy rainfall and as a result of domestic water use. These over-saturated soils tend to liquefy and flow rapidly downslope. Houses in Marin County have been damaged or destroyed both by being hit by fast-moving flows and undermined because foundations were embedded in soil that liquefied. Human activities that may contribute to landslides include steep cuts in the slope, improper placement of fill on slopes, concentrating surface runoff, or irrigation practices.

All of the conditions discussed above would be exaggerated in the event of an earthquake. Thus, it is essential that potential landslide hazards be examined by a geologist at the time of project development. Most landslide damage in Marin County has taken place within pre-existing landslide deposits as a result of continuing or renewed movement. The majority of these damaging landslides have occurred on slopes underlain by Franciscan melange.

In Eastern Marin County, an extensive hazard and mapping project was undertaken by the California Division of Mines and Geology. These maps show land stability patterns and classify areas according to relative slope stability. The relative slope stability maps use the United States Geological Survey (U.S.G.S) maps as a base map. They are at a scale of 1:12,000 or 1:24,000 and are available from the Marin County Planning Department. The zones are described below:

Figure 6 - Geology of Marin County



- Zone 1 - The most stable category. This zone includes resistant rock that is either exposed or is covered only by shallow colluvium or soil. Also included in this zone are broad, relatively level areas along the tops of ridges or in valley bottoms that may be underlain by material that is quite weak (such as Franciscan melange matrix and alluvium) but occupies a relatively stable position. Some landslide deposits that have moved to relatively stable positions at or beyond the base of the slopes from which they were derived are also included in zone 1.
- Zone 2 - Includes narrow ridge and spur crests that are underlain by relatively competent bedrock, but are flanked by steep, potentially unstable slopes.
- Zone 3 - Areas where the steepness of the slopes approaches the stability limits of the underlying geological materials. Some landslide deposits that appear to have relatively more stable positions than those classified within zone 4 are also shown here.
- Zone 4 - The least stable category. This includes most landslide deposits in upslope areas, whether presently active or not, and slopes on which there is substantial evidence of downslope creep of the surface materials. These areas should be considered naturally unstable, subject to potential failure even in the absence of human activities and influences. Banks along deeply incised streams are also included in zone 4.

The use of these slope stability maps is limited because of the large area involved and the widely varying conditions throughout the area. Despite this, the maps provide an aid to land use planning and should be consulted when a proposed development is being considered.

Subsidence and differential settlement

Present and former marshlands and mudflats are particularly susceptible to subsidence and differential settlement. The bay mud is a soft, unconsolidated, water-saturated silty clay, containing peaty plant remains and mollusk shells. Developments on fill placed upon the marshlands and mud flats of San Francisco Bay are prone to several stability problems. The continuing subsidence of fills results in intermittent flooding, and differential settlement damages structures, utilities, sewer lines, and roadways. These conditions create costly maintenance and repair problems. In addition to the problems mentioned above, the bay mud is highly compressible and subject to lateral flow when loads are placed on it. Ground shaking during an earthquake may trigger liquefaction.

Slope stability and subsidence (including liquefaction) pose a very real threat to life and property in Marin County. Much of the danger associated with these geologic events can be avoided by careful evaluation of site conditions and implementation of proposed mitigation measures. In particular, it is important

to locate critical facilities such as police and fire stations, hospitals, and communication centers outside of areas subject to risk.

C. FLOOD HAZARDS

A flood in Marin County may originate from watercourses, reservoirs, and coastal waters. Risks to the community from flooding occur primarily from development activity in the flood plain (land areas which may be inundated from storm runoff, tidal action, or high surf). Marin waterways regularly swell with storm water runoff and inundate developed areas. Portions of Mill Valley, Tiburon, San Rafael, Novato and the Ross Valley usually suffer some flood damage annually. High tides combined with storm water runoff create floods in low-land bayfront and Pacific Coast communities. Flood hazards along the Marin coast may increase over time due to the projected increase in the water level of the Pacific Ocean and San Francisco Bay. In addition, there are eight major dams and many smaller dams in Marin County which could flood inhabited areas, should they fail. Tsunamis and, to a lesser extent, seiches create flood risks.

It is important to avoid locating critical facilities (facilities which must remain operational in an emergency) in areas which may be subject to flooding. This should be taken into consideration during project review and existing facilities should be identified and relocated when possible.

Watercourse Floods

The storms in 1982 caused highly destructive flooding in Marin. Overflowing streams turned streets in San Rafael, San Anselmo, Fairfax, Ross, and Kentfield into raging rivers. Marin County was declared both a state and federal disaster area after the 1982 floods and the storm cost an estimated 100 million dollars in damage.

The approach to solving flood problems should focus on regulatory methods, rather than construction related methods. Regulatory methods such as floodplain zoning and development standards are currently being utilized in Marin County. It is possible to target areas subject to flooding for uses which can withstand periodic inundation. Construction-related methods of flood control are discouraged because they may further alter the natural waterway system.

The Marin County Flood Control and Water Conservation District oversees flood control improvements and revenue collection in eight flood control zones (Figure 7). The funds raised within a Flood Control Zone can be spent only in that zone as recommended by individual advisory boards which report to the Board of Supervisors. The Flood Control District has administered a number of flood protection measures including purchase of land, flood proofing of property, construction of berms and retaining walls, flood plain zoning, and major channel improvements.

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March 1989, KAH,



Dam Inundation

Dams in Marin County are located near the San Andreas fault and could rupture or spill water in the event of an earthquake or after a storm, causing flash flooding in populated areas. The severity of flooding would depend on the size of the earthquake, the amount of damage to dams, or the volume of water escaping from the dam.

The California Dam Safety Act of 1972 (SB 896) requires preparedness against the sudden failure of any dam which could result in death or personal injury. The Act requires that areas of potential flooding in the event of a dam failure be identified on inundation maps and that procedures be developed for emergency evacuation and control of populated areas within identified flood zones. See Figure 8 for areas subject to inundation. More detailed maps are available through the Office of Emergency Services.

Coastal Water Floods: Ocean and Bay

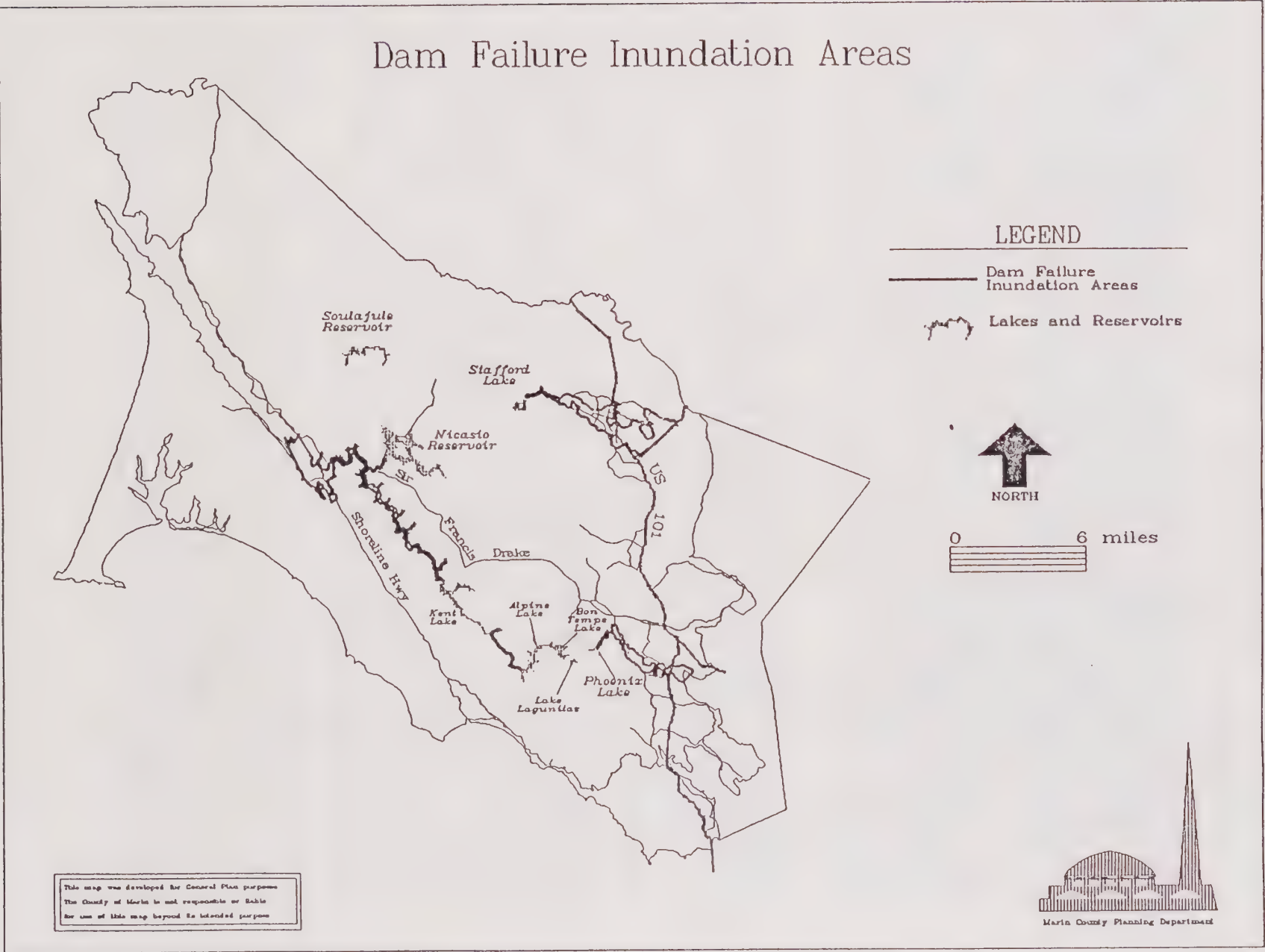
The simultaneous occurrence of very high tides, large waves, storm swells, and rain may cause flooding along the Marin coast and the Bay. In addition, a tsunami (discussed on p. 8) may create potentially destructive water waves.

Strong southern winds accompanied by high tides and heavy surf threaten Pacific Coast and bayfront communities. The Pacific Coast communities most threatened by coastal water floods include Bolinas and Stinson Beach. In addition, areas along the San Francisco Bay near Novato Creek, the Petaluma River, Point San Quentin, San Pablo Bay, San Pedro Peninsula, and Sausalito face significant flooding. The most recent storm to cause heavy damage in Marin County occurred in February 1983. A strong southern storm coupled with powerful winds and high tides flooded homes and businesses in San Rafael, Santa Venetia, and Stinson Beach. Pounding ocean waves destroyed five homes and damaged many others in the Seadrift area of Stinson Beach. High tidal waters poured over levees in San Rafael, flooding portions of East San Rafael. High tides also rushed through levees in Santa Venetia and flooded over 300 homes.

Rise in Sea Level

The projected rise in the water level of the San Francisco Bay poses a flood hazard not addressed in the 1977 Environmental Hazards Element. The San Francisco Bay Conservation and Development Commission (BCDC) projects that a global climate change will raise the Earth's temperature, melting ice caps, and accelerating the rise in sea level from the present rate of one-half foot per century to an average of four to eight feet in the next century. The BCDC recommends that the possible rise in sea level should be taken into consideration in land use planning efforts and that areas at risk should be identified. More information is included in a report prepared for the San Francisco Bay Conservation and Development Commission, Future Sea Level Rise: Predictions and Implications for San Francisco Bay, revised in October, 1988.

Figure 8 - Dam Failure Inundation Areas



D. FIRE HAZARDS

The eastern portion of Marin County and the West Marin communities of Bolinas and Stinson Beach are served by sixteen fire protection districts. (See Figure 9.) The State of California contracts with the County to provide protection to the "State Responsibility Area" which includes most of the inland rural and coastal portions of the County, as well as several communities, including Homestead Valley, Kentfield, Lucas Valley, Marin City, Marinwood, portions of Santa Venetia, and Tamalpais Valley (shown in Fig. 10).

Fire hazards in Marin County threaten lives, property, and the natural environment. Prevented from burning for as long as 40 years, Marin forest and chaparral areas contain old and highly flammable vegetation posing significant hazards to scenic environments and residential communities. Many Marin homes face increased fire risks due to steep slopes, narrow streets, flammable roofing materials, proximity to old and overgrown vegetation, and distance from fire stations.

Fire hazards in the County fall into two general categories; wildland fires which emanate from open chaparral, grassland or forest areas and can threaten adjacent residential communities; and structural fires which damage the home or the work place and may spread to other areas.

Wildland Fires

Vegetation, weather, topography, and the location of built areas on the edge of wildlands create wildland fire hazards in Marin County. Hot, dry summers reduce plant moisture and make vegetation more susceptible to burning. Unpredictable winds near the ocean, along ridge lines and in steep drainages spread wildland fires quickly and erratically by changing fire direction and speed. Steep slopes allow lowland fires to preheat vegetation before climbing hillsides, increasing the rate of fire spread and impeding firefighter access. Communities located in the urban fringe face risks in the event of a wildfire. These risks are increased by flammable building materials, stilt and pole construction along steep slopes, poor road access, confusing street addresses, and dense vegetation immediately surrounding homes near the wildland.

A major wildland fire in Marin could cause severe damage to open space and park lands. Fire fighting efforts require bulldozing, road cutting and the use of fire retardant chemicals which would scar the land. Rainfall following a major fire could cause severe erosion, landslides and mudslides, further disrupting plant renewal by displacing topsoil and possibly endangering roads and homes. Residences located near forest, brush, or grassland areas are also threatened by wildland fires. Many of these homes are surrounded by trees and brush and this dry natural cover can set a home on fire in the event of a major wildland fire.

Figure 9 - Marin County Fire Districts

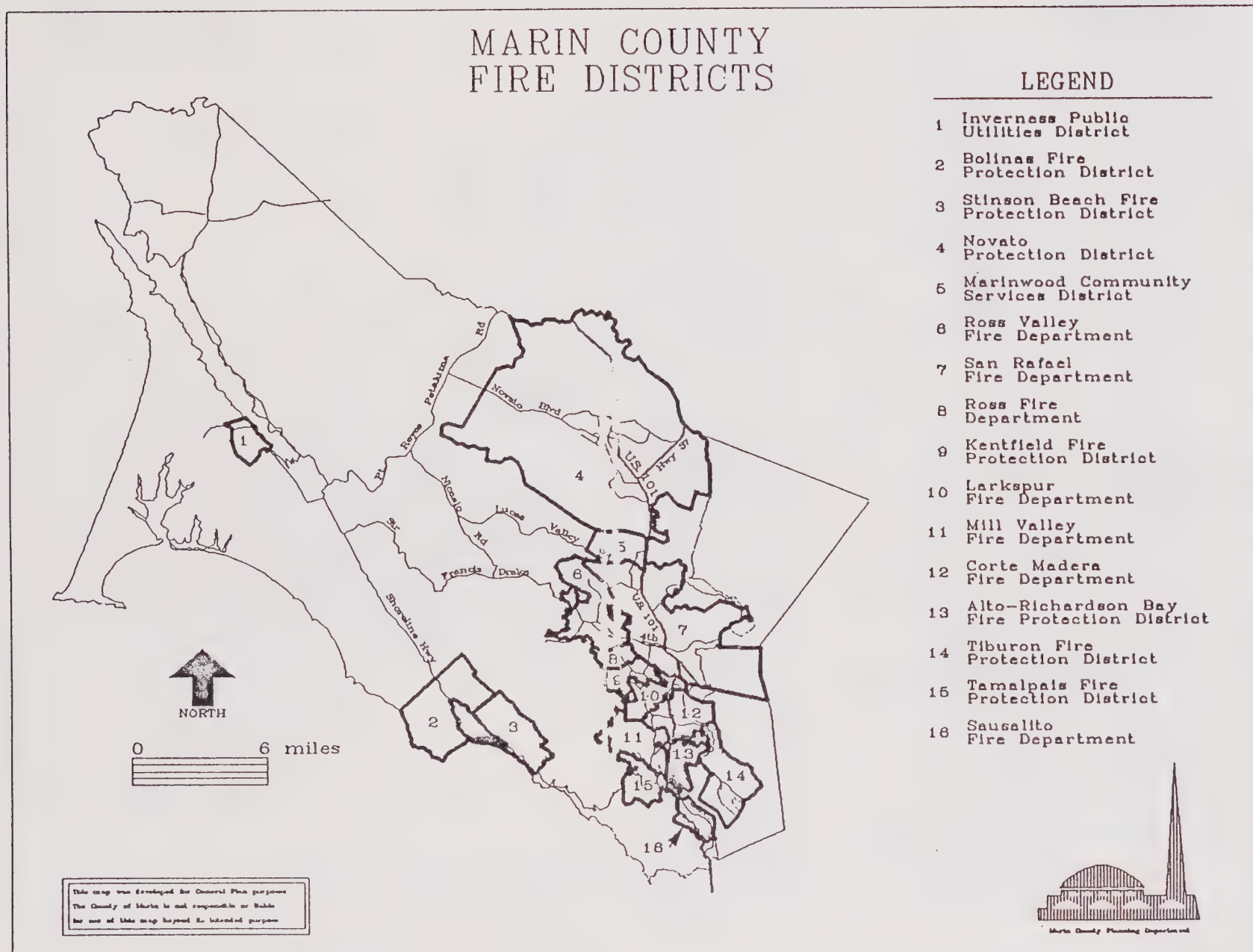
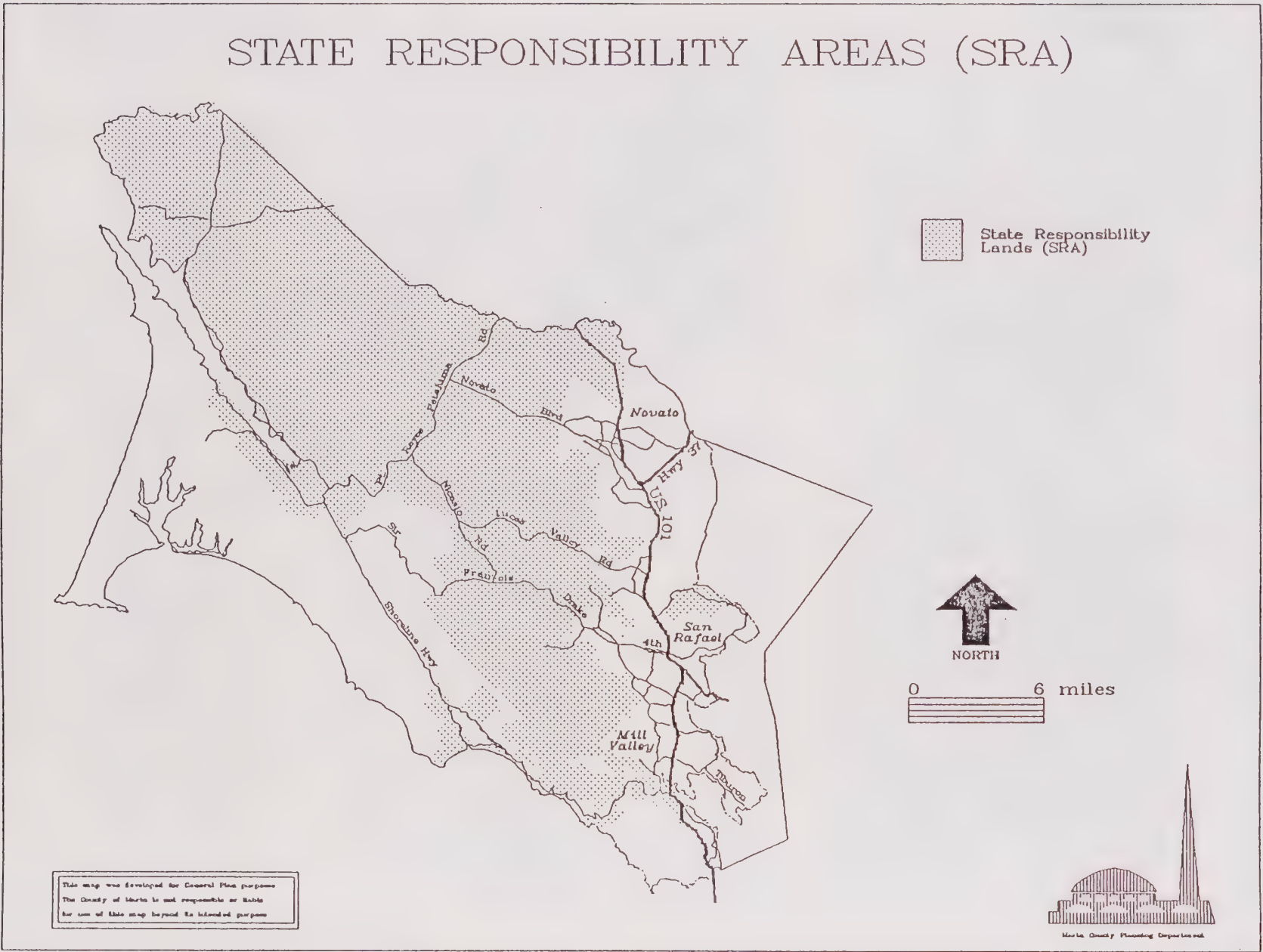


Figure 10 - State Responsibility Areas (SRA)

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Structural Fires

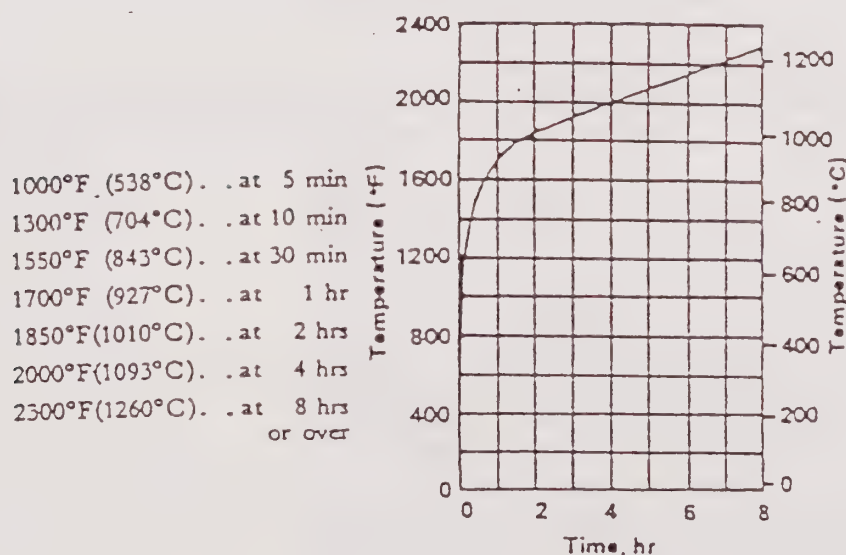
All buildings, including homes, businesses, and recreational facilities, face structural fire risks. Structural fires in Marin between 1978 and 1986 caused \$23 million in structural damage and \$10 million in content damage to homes in the County. These fires also injured 179 people and caused 16 deaths.

The lack of adequate water supply for fire fighting, poor access to structures, and delayed emergency response may increase fire losses. A survey of fire departments in the County, conducted from July to September of 1987, revealed the presence of conditions which increase the risk of losses from structural fires in Marin unincorporated areas. Existing conditions contributing to risk of loss in Marin structural fires include: 1) long response time, 2) inadequate road access, 3) poor water supply.

Fire Construction Standards

The necessity of requiring fire safety construction standards will vary depending upon the response time, access, and water supply. Five minutes after the outbreak of a structural fire, temperatures reach a level causing significant damage. These temperatures are high enough to instantly ignite most interior materials; the ignition temperature of wood is 508 degrees, cotton 410 degrees, and synthetic fiber is 600 degrees Fahrenheit. Thus, five minutes is considered the critical response time. (See Figure 11.)

Figure 11. The Time Temperature Curve



Source: National Fire Protection Agency, Building Construction Materials, 1985.

In Marin County, fire construction standards vary with each jurisdiction and fire protection area. In the State Responsibility Areas, the State Fire Marshall may define fire hazard zones and apply special construction standards in those zones, such as fire retardant roofs. Outside of the State Responsibility Area, fire districts often recommend that fire retardant roofing be required as a condition of approval for discretionary projects.

Fire related building standards for structures in Marin cities, towns and unincorporated areas differ among jurisdictions (Community Facilities Technical Report #1 lists each jurisdiction's requirements). Building standards not included in local government codes may be suggested by local fire officials in response to individual development applications. In the unincorporated areas, fire districts may comment on discretionary development applications when these applications have been referred to them by the Planning Department. Those comments may be incorporated as conditions of approval for the project. Thus, the application of fire safety requirements is not necessarily uniformly applied throughout the County.

For permits which are not discretionary, such as a permit for a single-family home on an existing lot, the Uniform Building Code and Uniform Fire Code establish the regulations for fire safety. These regulations are generally less strict than requirements recommended by the fire districts.

III. OBJECTIVES, POLICIES AND PROGRAMS PERTAINING TO ALL ENVIRONMENTAL HAZARDS

Objective EH-1: To stimulate public awareness of environmental hazards.

Policy EH-1.1 Support for Public Awareness. Support public awareness of environmental hazards by actively advising citizens of the availability of countywide and local area hazards studies, sources of hazard information and public services.

Program EH-1.1a Public Information. The County should prepare a handout designed to inform prospective property owners about potential safety hazards, which may exist on properties within Marin County.

Program EH-1.1b Maps available. The County should make available to the public maps depicting the areas covered by the Alquist Priolo Special Studies Zone Act.

Program EH-1.1c. Improve Soils Information. The County should develop a systematic and accessible compilation of existing drilling log data in filled and bay mud areas.

Policy EH-1.2 Support Scientific Geologic Investigations. Continue to support scientific geologic investigations to refine, enlarge and improve the knowledge about active fault zones, areas of instability, severe ground shaking and similar hazardous conditions in Marin County.

Objective EH-2: To protect public health and safety through safe location and rehabilitation of public structures.

Policy EH-2.1 Location of Public Structures. Structures necessary for the protection of public safety and/or the provision of emergency services should not be located in areas subject to inundation, subsidence, slope failure, or where they could not withstand ground failure in a seismic event, unless the only alternative location would be so distant as to jeopardize the safety of the community serviced, and provided that adequate precautions are taken to protect the facility.

Program EH-2.1a Project Review Procedures. The County Planning Department shall provide reference maps to be used in project review in order to avoid locating such structures in subject areas.

Policy EH-2.2

Emergency Building Design. Emergency buildings and vital utilities, communication systems, streets and other public facilities should be designed so that they remain operational during and after an earthquake, or any other disaster.

Policy EH-2.3

Critical Facilities. Within designated fault zones, the following critical public uses should be prohibited: schools, hospitals, utility and public safety facilities, high density housing and reservoirs.

Objective EH-3: To minimize hazards to the public from private construction located in hazardous areas.

Policy EH-3.1

Location of Future Development. All construction shall be located to avoid or minimize the hazards from earthquake, erosion, landslides, floods and fire. Development should not be endangered by nor contribute to hazardous conditions on the site or on adjoining properties.

Program EH-3.1a. **Project review.** The Planning Department shall continue to review the impact of a project on the site and surrounding properties.

Policy EH-3.2

New Development Approval. New development will be approved in the areas of identified geologic hazards only if the hazards can be reduced to acceptable levels by mitigation measures, the design and aesthetic considerations are appropriate for the site, and improvements are consistent with other policies in the Countywide Plan.

Program EH-3.2a. The County Planning Department should continue to require mitigation measures for projects proposed in areas with identified geologic hazards.

Policy EH-3.3

Disaster Protection Measures The health and safety of all members of the public, including people with disabilities, should be protected during and following a disaster, through safety measures at places of employment, residence, and public gatherings.

Program EH-3.3a. Project review procedures should continue to take into consideration the health and safety of members of the public.

Objective EH 4: To protect public health and safety from ground rupture hazards.

Policy EH-4.1

Alquist-Priolo Special Study Zones. The Alquist-Priolo Special (Seismic) Studies Zone Act shall continue to be implemented by the County and efforts should be made to inform applicants early in the development process of the existence of known fault traces which might affect their property, site development, and design.

Policy EH-4.2

Location of Structures. No structure for human occupancy, or which will imperil structures for human occupancy, public or private, shall be permitted to be placed across the trace of an active fault as confirmed through geologic investigation. This policy shall not be interpreted as being more restrictive of single-family residential construction than the Alquist-Priolo Act. It is assumed that the area within fifty (50) feet of an active fault is underlain by active branches of that fault unless and until proven otherwise by an appropriate geologic investigation.

Program EH-4.2a

Project Review Procedures. The Department of Public Works should continue to determine the applicability of the Alquist-Priolo Act, and, if necessary, require a site investigation report by a registered geologist.

Policy EH-4.3

Public Financing Support. Public financing or support should be withheld from buildings within the Alquist-Priolo Special Studies Zone where there is a confirmed fault trace, unless it can be established that there is no potential for surface fault displacement or ground rupture which would injure the public investment.

Policy EH-4.4

Geologic Investigation Requirement. No new building sites should be created within the Alquist-Priolo Special Studies Zone unless an appropriate geologic investigation establishes sufficient and suitable land area for development according to existing zoning and other applicable County ordinances.

Program EH-4.4a

Applications for Development. The County shall require that applications for development or division of land into two or more parcels located within the Alquist-Priolo Special Studies Zone be accompanied by a geologic report prepared by an engineering geologist and directed to the problem of potential surface fault displacement through the project site unless a waiver has been approved by the State Geologist.

Objective EH-5: To protect public health and safety from seismic ground shaking hazards.

Policy EH-5.1

Mitigation of Risk. The development of structures for human habitation, including residential, commercial and industrial uses, shall incorporate engineering measures to mitigate against risk to life safety in the areas identified as subject to ground shaking, at least to the extent provided by Title 19, Marin County Code.

Policy EH-5:2

Geotechnical Investigation Requirements. Applications for developments proposed to be sited on landslide deposits, non-engineered fill, or bay mud shall be accompanied by a geotechnical engineering investigation directed to the problem of ground shaking and ground failure.

Program EH-5.2a

Requirements for Soils and Geologic Reports. The Planning Department shall continue to require submission of soils and geologic reports with master plan applications, soils and/or geologic reports with subdivision applications.

Policy EH-5.3

Potential Earthquake Hazard in Existing Buildings. The County should minimize potential earthquake damage from existing public buildings by structural strengthening, eliminating hazardous features or relocating buildings.

Program EH-5.3a

Structural Improvements. The Department of Public Works should identify structural improvements in public buildings necessary for safety and develop measures to institute improvements.

Program EH-5.3b

Compliance with SB 547. The Department of Public Works should identify unreinforced masonry buildings, buildings and adopt an ordinance by 1990 that requires strengthening or demolition of the buildings identified, to comply with SB 547.

Policy EH-5.4

Location and Design of High-Occupancy Structures. The design of structures to be occupied by a large number of people, such as restaurants and hotels, shall take into consideration any constraints dictated by the site conditions, as determined by the engineering geologist and civil engineer conducting the site investigation.

Program EH-5.4a High Density Structures. The Department of Public Works should determine that structures which are to be occupied by a large number of people (as described in 5.4), are designed to be as safe as similar structures in locations not subject to excessive ground shaking or other geologic hazard.

Objective EH 6: To protect public health and safety from slope instability and landslide hazards.

Policy EH-6.1 **Evaluate Projects in Areas Rated 3 or 4 in Stability.** Projects proposed for areas rated 3 or 4 in stability and landslide potential (classification 9 California Division of Mines and Geology) shall be evaluated by the Department of Public Works and accompanied by a report prepared by a civil engineer with soils engineering expertise or a soils certified engineering geologist prior to consideration of site design or use. The evaluation should include the structural foundation engineering of the actual site, the impact of the project on adjacent lands, as well as impacts of off-site conditions on the site itself.

Policy EH-6.2 **Construction Observation and Certification.** If work is undertaken to correct the instability, the County should require that the work be supervised and certified by a geotechnical engineer and, where deemed necessary, an engineering geologist.

Policy EH-6.3 **Projects on Known Landslides and Landslide-Prone Deposits** Known landslides and landslide-prone deposits on steep slopes should not be used for development except where engineering, geologic site investigations indicate such sites are stable or can be made stable if appropriate mitigation measures are taken. In such cases, it must be shown that the risk to persons or property or public liability can be minimized to a degree acceptable to the County.

Program EH-6.3a Project Review. The County should continue project review procedures which may require soils and/or geologic reports to be reviewed by the Department of Public Works.

Objective EH 7: To protect public health and safety from subsidence and differential settlement hazards.

Policy EH-7.1

Filled Land Underlain by Compressible Materials.

Soils investigations for projects on filled land which is underlain by compressible materials (bay mud, marsh, slough) should delineate those areas where settlement will be greatest, and subsidence may occur, and should recommend site preparation techniques which could be employed to preclude hazard. Soils investigations should include borings, identify former sloughs, and address any other factors which would accentuate differential settlement.

Policy EH-7.2

Minimizing Differential Settlement. In the areas of greater potential for differential settlement, uses should be planned which would not be damaged by such activity and which would provide minimum inducement to settlement which is detrimental to persons, property and public investment.

Program EH-7.2a

Soils Report Requirement. The County shall continue to address differential settlement and subsidence in required geologic reports.

Program EH-7.2b

Findings Requirement. In areas which have been identified as being susceptible to differential settlement, the Public Works staff must make the finding that the proposed fill, excavation or grading will not unduly or unnecessarily create a safety hazard. The finding may be appealed to the Planning Commission.

Program EH-7.2c

Site Preparation Requirements. When recommended by the geotechnical engineer, site preparation shall include several years of settlement monitoring sufficient for detailed foundation engineering and site planning to be based on the site's particular characteristics.

Policy EH-7.3

Structural Design of Foundations and Utilities.

Structural design of foundations and utilities shall recognize the potential for differential settlement and subsidence.

Program EH-7.3a

Enforce Development Standards. The Department of Public Works should continue to enforce development standards with particular reference to minimum elevations and ultimate settlement. The Building Inspection Department should continue to enforce building code requirements for structural design of foundations and utilities.

Program EH 7.3b Augmented Expertise. The Department of Public Works should continue to hire consultants in soils engineering as necessary in order to specifically evaluate development proposed on bay mud and fill.

Policy EH-7.4 Identify Inadequately Engineered Fills. The Department of Public Works should continue to determine the adequacy of engineered fills prior to the construction of structures.

Objective EH 8: To assure public safety in areas subject to inundation.

Policy EH-8.1 Location of Critical Facilities. Public safety structures should not be located within the range of a tsunami.

Program EH-8.1a Review Procedures. The County should utilize the California Environmental Quality Act environmental review procedure to review and direct the siting of critical facilities structures in tsunami hazard areas.

Policy EH-8.2 Construction. Improvements should be designed to withstand impact from the tsunami and the debris it will carry. Those structural features which could become dislodged or detached (docks, decking, floats, vessels) should be situated so that they do not become potential implements of destruction.

Program EH-8.1b Implement Regulations. The County shall continue to implement the regulations of Marin County Code Title 23.09, Flood Plain Management, which establish Coastal High Hazard Zones with special locational and construction standards for all land uses subject to tsunamic inundation.

Policy EH-8.2 Multiple Use. The County should continue to promote the multiple use of areas set aside for flood retention ponding purposes (i.e. agriculture, open space, education, ecology), provided these uses are tolerant of occasional flooding.

Program EH-8.2a Application Review. The County should encourage the multiple use of ponding and encroachment areas designated under Title 23 (Flood Plain Management), and the use of lands reserved for flood plains under the Floodway Zoning provisions of Title 22 (Zoning) through the application review process.

Policy EH-8.3

Regulatory Methods of Flood Control. The County should encourage regulatory methods (rather than construction-related methods) of flood control which reduce the need for flood control projects, minimize losses in areas where flooding is inevitable, and ensure that those who occupy flood hazard areas are aware of the risks and assume responsibility for their actions.

Program EH-8.3a Flood Hazard Zone Polices and County Code Provisions. The County shall continue to support and enforce policies and the Marin County Code pertaining to special flood hazard zones, including the Coastal High Hazard Zone (Title 23, Flood Plain Management), the Bayfront, Flood Plain, Tidelands, and Coastal Zones, Title 11 (Watercourse Obstruction), Title 22 (Floodplain Districts), and the provisions of Title 20 (Subdivisions).

Program EH-8.3b Clarify Zoning Ordinance. The County Planning Department should strengthen and clarify references to flood hazard areas occurring along the San Francisco Bay, Tomales Bay, and the Pacific Ocean in the zoning ordinance sections pertaining to the Bayfront Conservation Zone, the Coastal Zone, the Planned District Zones, and the Tidelands Zone.

Program EH-8.3c Refer Applications. The County Planning Department shall continue to refer all permit applications for proposed construction, substantial improvements and other development to the Department of Public Works to determine whether development is proposed within flood prone areas and therefore subject to the provisions of Title 23.09, Flood Plain Management.

Program EH-8.3d Restrict Dangerous Uses. The County shall enforce the special locational, storage, water supply and sewer, subdivision, and mobile home standards for flood hazard areas identified in Title 23 restricting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in increases in erosion or in flood heights or velocities.

Program EH-8.3e Apply Construction Standards. The County Planning Department shall require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction by applying the construction standards of the Marin County Code, including Title 23, Flood Plain Management.

Program EH-8.3f

Restrictions in Floodways. The County should support special restrictions in floodways and watercourses due to the extreme hazards posed by floodway development which can increase the risks associated with the velocity of flood waters carrying debris, potential projectiles, and erosion potential. This includes prohibiting encroachments in watercourses, prohibiting structures within a primary floodway, and restricting building in a secondary floodway or flood fringe which would increase risks to public health and safety in the event of a flood.

Policy EH-8.4

Zoning Overlays. The County should expand the use of flood plain zoning overlays in flood areas to minimize flooding hazards.

Policy EH-8.5

Flood Runoff. The County should insure adequate capacity to handle anticipated flood runoff in stream channels by restricting development, storing, ponding, or maintenance dredging instead of major structural improvements whenever feasible. The County should control filling, grading, dredging, and other development which may increase flood damage by increasing sedimentation in streams and watercourses and increasing the amount of impervious surface in an area.

Program EH-8.5a

Enforce County Code. The County shall continue to enforce the provisions of Titles 11, 19, 20, 22 and 23 regarding grading, excavation, filling, and dredging.

Program EH-8.5b

Hydrologic and Geologic Studies. The County should require detailed hydrologic and geologic studies in development projects which have the potential for increasing sedimentation of watercourses, increasing impervious surface, or altering natural drainage patterns so as to insure adequate capacity to handle flood runoff safely.

Program EH-8.5c

Re-Evaluate flood prone areas. The County should re-evaluate flood prone areas periodically regarding changes to elevations as a result of off-site development or natural forces.

Policy EH-8.6

Flood Barriers. The County should prevent the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas.

Objective EH-9: To protect the public from the consequences of a dam failure, or inundation from a seiche in the event of an earthquake.

Policy EH-9.1

Dam and Levee Design. Dams and levees should be designed and located to insure safety from all maximum credible potential seismic and hydrologic events.

Program EH-9.1a

Enforce County Code. The County shall continue to enforce the provisions of Titles 11.04 (Dams), 23.08 (Excavation) which allows the County to review applications for dam permits where dam size is below that requiring a permit from the State of California.

Program EH-9.1b

Inspect Levees. The County should continue to inspect existing levees and review new levees for seismic and hydrologic safety.

Policy EH-9.2

Notify Property Owners. Property owners within areas of possible inundation due to dam failure of the eight major dams should be notified regarding susceptibility to flood hazard.

Program EH-9.2a

Public Information Regarding Dam Inundation Areas. The County should make information available to the public regarding the location of dam inundation areas, for the eight major dams in the county.

Objective EH-10: To minimize the effects of potential flooding due to the projected rise in sea level.

Policy EH-10.1

Rise in Ocean Level. The County should evaluate the potential for a rise in the level of the ocean and bay and develop a program for integrating information about such a rise into the on-going flood control planning efforts of the County.

Program EH-10.1a.

Modify Construction Standards. The County Planning Department should work with the County Flood Control and Water Conservation District and the Department of Public Works to prepare responses to a potential rise in the sea level. The County should consider the development of flood control projects and the modification of Marin County Code Chapters 11, 22, and 23 to include construction standards for areas subject to increased flooding due to a rise in the sea level.

Program EH-10.1b Monitoring Stations. The County, in conjunction with U.S.G.S., the San Francisco Bay Conservation and Development Commission, and any other interested agencies should establish monitoring stations to track the rise in Bay and ocean water levels.

Objective EH-11: To minimize the risk of wildland and structural fires, and ensure adequate fire protection.

Policy EH-11.1

Map Fire Hazards. The County should have information available regarding areas which are considered extreme fire hazards.

Program EH-11.1a Maps for Public Review. The County Planning Department, in coordination with the County Fire Marshall, should map known fire hazard areas subject to wildland fire risk and make these maps available to planners and the public for use in project review where building standards designed to reduce the risk of fire may be applied.

Program EH-11.1b Five-Minute Response Time. The County Planning and Building Departments in consultation with the County Fire Marshall and Fire District Officials serving the unincorporated County should identify and map areas beyond a five minute response time and consider these as extreme fire hazard areas subject to automatic sprinkler requirements.

Policy EH-11.2

Permit Referral. Land development and residential building permit applications should be referred to the County Fire Department or pertinent local fire district for review and recommendation.

Program EH-11.2a Building Standards. The County Planning Department should collaborate with the Department of Public Works and Fire Districts serving the unincorporated County to develop building standards for fire safety in lieu of a permit referral system.

Program EH-11.2b Conditions of Approval. Recommendations made by fire authorities on discretionary planning permits should be included as conditions of approval of those permits when the Planning Department staff determines that these recommendations are necessary for safety reasons.

Program EH-11.2c County Code. Requirements for referrals of discretionary planning permits to County fire officials should be specified in the County Code.

Policy EH-11.3

Mitigate risk in New Land Divisions. New subdivisions and land divisions in areas identified as having extreme fire hazards should only be allowed where it is determined that adequate water for fire suppression is or can be made available. For residential subdivisions, access should be provided from more than one source where feasible. Fire trails and fuel breaks should be required when necessary. If development is to occur in extreme fire hazard areas, fire-resistant materials, clearances from structures, and landscaping with fire-resistant plants should be required.

Program EH-11.3a Adequacy of Standards. The Planning Department in conjunction with fire officials should evaluate the adequacy of standards for water supply and road access to subdivisions in the County Building, Subdivisions and Zoning Codes (Marin County Code Titles 20 and 22).

Program EH-11.3b Fire Retardant Roofing. The Planning Department should amend the Marin County Code to incorporate a requirement for Class-C fire-retardant roofing in all County unincorporated areas to bring all portions of the County into conformance with fire-retardant roofing standards presently in place for State Responsibility Areas in Marin.

Program EH-11.3c Brush Clearance. The Planning Department should amend the Marin County Code to establish uniform standards for clearance from structures, landscaping, and fire-resistant building materials (particularly pole construction), for all new construction in fire hazard areas.

Policy EH-11.4

Fuel Breaks and Access Routes. The Marin County Fire Department or other local fire protection agencies in concert with the Marin County Open Space District, the State Division of Forestry and the National Park Service, should encourage and promote the maintenance of existing fuel breaks and emergency access routes for effective fire suppression.

Policy EH-11.5

Uniform Fire Code. The Board of Supervisors and the appropriate County agencies and all other agencies having fire protection responsibilities should continue to implement the latest Uniform Fire Code.

Program EH-11.5a

Review County Code. The Marin County Code should be periodically reviewed by the Planning Department, Department of Public Works, and fire officials, to insure conformance with the latest Uniform Codes.

Policy EH-11.6

Hazardous Vegetation. The County should plan for the systematic and environmentally sound reduction of hazardous vegetation to reduce the buildup of old and hazardous vegetation created by effective fire suppression activities over the last 40 years.

Policy EH-11.7

Fire Safety Standards. The County should implement fire safety standards developed by the State of California for the State Responsibility Areas in a uniform manner to insure comparable safety standards for all new construction in the County and to simplify the development review process.

Program EH-11.7a

Conformance with Fire Safety Standards. The Planning Department, in conjunction with fire officials, should revise the Marin County Code to bring it into conformance with State Responsibility Area construction and fire safety standards.

ENVIRONMENTAL HAZARDS ELEMENT
TECHNICAL REPORT #1 (FLOODS)
FLOOD HAZARDS: EXISTING CONDITIONS AND RECENT STUDIES

MARIN COUNTY PLANNING DEPARTMENT
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DRAFT DOCUMENT AS OF FEBRUARY, 1988

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ENVIRONMENTAL HAZARDS ELEMENT
TECHNICAL REPORT #1 (FLOODS)
FLOOD HAZARDS: EXISTING CONDITIONS AND RECENT STUDIES

I. SUMMARY

The Marin Countywide Plan Environmental Hazards Element, adopted in 1977, must be updated to include the findings of recent flood studies and State of California requirements for hazards planning. This technical report examines existing flood hazard conditions and proposes amendments to the Countywide Plan Environmental Hazards to address them.

The risk of serious flooding threatens a number of Marin communities located in the path of watercourses, near the Pacific Coast, and along the San Francisco Bay. Considerable Marin County development has occurred in or near flood plains where storm water runoff, tidal action and high surf regularly cause flooding. Storm related and coastal flooding has occurred frequently in Marin; the County experienced major flooding from these sources in 1952, 1955, 1958 1967, 1970, 1973, 1975, 1978, 1982, 1983, and 1986.

In addition to current flood problems, Marin communities may face increased flooding caused by a projected rise in the water level of the Ocean and the Bay. Some Marin communities also face inundation from a failure at one of Marin's 8 dams following a major earthquake.

The risk of flooding in Marin is a costly problem for property owners and local governments. The public and private cost of flooding in Marin County reached an estimated 100 million dollars in 1982 alone. Flooding often effects property owners and local governments uninsured against flood loss; just 10 out of the over 100 million dollars in flood damage between 1977 and 1986 involved insured property owners.

Marin County government agencies engage in a number of flood protection measures. The Marin County Department of Emergency Services is preparing a County Multi-Hazard Plan which outlines actions to insure effective disaster response. The Marin County Flood Control and Conservation District coordinates flood control construction projects funded and approved by the eight Flood Control Zones in the County. The Marin County Code includes a number of sections restricting development in the flood plain: Bayfront Conservation Zoning, Flood Plain Zoning, Tidelands Zoning, and Flood Plain Management Regulations.

Modifications to the Environmental Hazards Element proposed in this technical report focus on incorporating the findings of recent studies and on supporting current flood control activities. Suggested Element

revisions include changes to the wording of existing policies and the addition of new policies. These policy changes would: (1) provide support for recently approved flood plain management regulations, (2) expand the application of flood plain zoning, (3) provide public information about the risk of dam failure flooding, and (4) recommend additional County actions to monitor the sea level rise and protect Marin citizens against flooding caused by increases in the water level of the Bay and Ocean.

II. PURPOSE

The current Environmental Hazards Element, adopted in 1977, has not been revised to include recent flood hazard studies and legislation. This technical report reviews current legal authority for flood hazard planning, flood problems in Marin County, and current flood protection measures. The report also suggests revisions to the Countywide Plan Environmental Hazards Element which will improve conformance with existing environmental and programmatic conditions.

II. AUTHORITY

The authority under California law for local flood hazard planning includes the California State Constitution, the California Government Code, and the California State Dam Safety Act of 1972. Under Federal law, the National Flood Insurance Act of 1968, and the Flood Disaster Protection Act of 1973 delegate specific authority to local governments to apply and enforce federal standards in flood control planning.

The California State Constitution, Article II, Section 7, delegates the responsibility for adopting flood plain zoning to local governments. Such zoning regulations must be based on local policy documents, including the general plan.

The California Government Code requires cities and counties to protect the public against unreasonable risk due to flooding (Sections 65302(d) and (g), 1980) through the general plan. The State Government Code authorizes localities to require flood studies for parcel and final subdivision map applications (Section 66434.2, 1985). The Government Code also obligates governments to consider the effects of flooding from tsunami, seiche, and dam failure in addition to storm runoff and tidal activity in the safety element of the general plan (Section 65302, 1980).

The California Dam Safety Act of 1972 (SB.896) requires local governments to map areas subject to inundation from dam failure. Pursuant to the Act, State Water Code Section 6002 authorizes the State Division of Dam Safety to permit, inspect, and require mapping of all dams over fifteen feet in height and over 1,500 acre-feet of capacity. The Dam Safety Act also obligates local governments to notify property owners within dam inundation areas regarding the possibility of a dam failure.

The National Flood Insurance Act of 1968, and the Flood Disaster Protection Act of 1973 authorize the Federal Emergency Management Agency to conduct Flood Insurance Studies and establish insurance rates for properties falling within identified flood zones. These rates create economic incentives for sound flood plain management and land use planning. The reports and maps provided by the Federal Emergency Management Agency identify the 100 year flood plain (the land area expected to flood once

every 100 years), and base flood elevations (the anticipated level of water in the 100 year flood). Marin County building officials use these materials in evaluating development applications and flood control projects.

IV. FLOOD PROBLEMS IN MARIN COUNTY

Flooding in Marin County poses a serious threat to public health and safety, property, commerce, and governmental services. The threat of flooding necessitates extraordinary public expenditures for flood protection and relief. Damage from flooding in the years 1977 through 1986 caused 10.8 million dollars insured damage in the County as whole, and 2.9 million dollars in the County unincorporated area. These figures are far below actual public and private damage totals because they only include damage to properties insured under the National Flood Insurance Program. The estimated cost of public and private damage in Marin County exceeded 100 million dollars in 1982, 9 million dollars in 1983, and 8 million dollars in 1986 (Marin Independent Journal, 2-17-86 and 3-14-83). The amount of flood insurance claim payments and number of claims by city are shown in Table 1, Total Flood Damage in Marin County, and Table 2, Flood Damage in Marin County Jurisdictions.

Table 1
Total Flood Damage in Marin County
Measured in Flood Insurance Claim Payments
1977-1986

Year	Cases	Amount
1977	3	\$11,445
1978	24	\$106,065
1979	11	\$45,363
1980	61	\$154,586
1981	21	\$21,668
1982	635	\$5,040,945
1983	466	\$4,144,677
1984	3	\$2,969
1985	2	\$3,210
1986	196	\$1,276,460

TOTAL	1422	\$10,807,388

Table 2
Flood Damage Measured in Flood Insurance Claim Payments
Marin County 1977-1986

Jurisdiction	Year	Payments	Amount Paid
Belvedere	1982	21	\$131,451
	1983	25	\$243,738
	TOTAL	46	\$375,189
Corte Madera	1977	1	\$3,294
	1981	2	\$2,680
	1982	57	\$629,229
	1983	9	\$85,000
	1984	2	\$2,534
	1986	66	\$417,252
	TOTAL	137	\$1,139,989
Fairfax	1978	1	\$3,000
	1980	2	\$3,023
	1981	2	\$814
	1982	12	\$19,478
	1983	2	\$22,711
	TOTAL	19	\$49,026
Larkspur	1978	2	\$2,973
	1981	2	\$1,119
	1982	15	\$128,396
	1983	26	\$208,759
	TOTAL	45	\$341,247
Mill Valley	1977	2	\$8,151
	1978	5	\$10,907
	1979	7	\$16,803
	1980	7	\$24,385
	1982	49	\$177,771
	1983	13	\$84,524
	TOTAL	83	\$322,541

Novato	1980	23	\$37,805
	1982	162	\$1,308,110
	1983	9	\$8,910
	TOTAL	194	\$1,354,825
Ross	1980	2	\$1,068
	1981	1	\$75
	1982	64	\$779,325
	TOTAL	67	\$780,468
San Anselmo	1978	2	\$1,998
	1979	1	\$487
	1980	1	\$1,075
	1982	52	\$401,086
	TOTAL	56	\$404,646
San Rafael	1978	4	\$20,769
	1979	1	\$2,817
	1980	8	\$44,704
	1981	4	\$4,919
	1982	82	\$814,756
	1983	181	\$1,526,642
	1986	77	\$608,904
	TOTAL	357	\$3,023,511
Sausalito	1978	2	\$1,329
	1980	1	\$401
	1982	2	\$1,323
	1983	5	\$20,690
	TOTAL	10	\$23,743
Tiburon	1980	1	\$351
	1981	2	\$1,662
	1982	5	\$32,921
	1983	4	\$12,431
	TOTAL	12	\$47,365

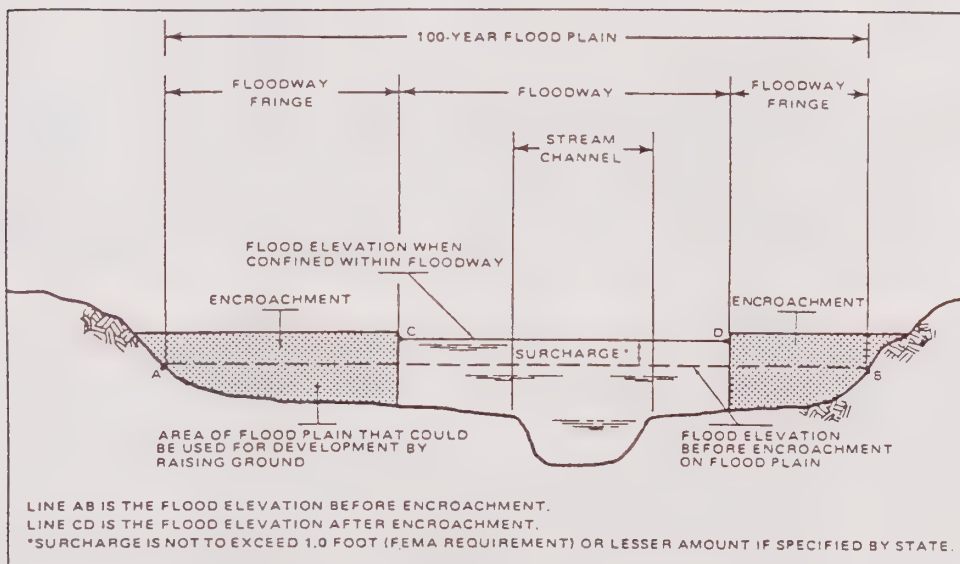
Unincorporated	1978	8	\$65,089
	1979	2	\$25,256
	1980	16	\$41,774
	1981	8	\$10,399
	1982	114	\$617,099
	1983	192	\$1,931,272
	1984	1	\$435
	1985	2	\$3,210
	1986	53	\$250,304
<hr/>			
	TOTAL	396	\$2,944,838
GRAND TOTAL		1422	\$10,807,388

Risks to the community from flooding occur primarily from development activity in the flood plain: land areas which may be inundated from storm runoff, tidal action, or high surf. Land uses located in the flood plain may be destroyed or severely damaged during a flood. Development and other obstructions in the flood plain also raise the height and erosive velocity of flood waters, spreading flood damage over a greater area.

The hazards associated with flooding differ according to the presence of development and other encroachments in the flood plain. The Federal Emergency Management Agency identifies two portions of a flood plain: the floodway and the flood fringe. Floodways are watercourses which must be kept free of obstructions so that flood heights and destructive power do not increase. Floodways include streams, low-lying areas which fill with fast-moving storm waters, and coastal areas subject to powerful wave or tidal action. Flat expanses of land which fill with slower waters spreading out from the floodway are known as the flood fringe. Flood fringes and floodways have been developed in Marin, necessitating costly public works projects and rigorous construction standards to minimize disaster losses. The distinction between floodways and flood fringes is shown in **Figure 1, Floodways and Flood Fringes.**

Marin floods originate from watercourses, reservoirs, and coastal waters. Marin waterways regularly swell with storm water runoff and inundate developed areas, and flooding both inland and coastal communities. Several populated areas in the County would be flooded in the event of dam failure following a major earthquake. High tides combined with storm water runoff create floods in low-land bayfront and Pacific Coast communities. Flood hazards along the Marin coast may increase over time due to the projected increase in the water level of the Pacific Ocean and the San Francisco Bay.

Figure 1
Floodways and Flood Fringes



Source: Federal Emergency Management Agency, 1986.

A. Watercourse Floods

Watercourse floods in Marin can develop from storm water runoff within 24 hours after the beginning of a storm. Rainfall in Marin is heavy and rainy season flooding frequent. Major floods since 1950 have occurred in 1952, 1955, 1958, 1967, 1970, 1973, 1975, 1978, 1982, 1983 and 1986. Flood-producing storms generally occur between December and March and last three to four days.

Poor soil drainage increases surface water runoff in a storm and may cause flooding along hillsides as runoff rushes towards valleys and watercourses. Inadequate capacity may cause flash flooding where watercourses rise quickly in heavy rainstorms and spill flood waters into developed areas. Flash flooding may also occur as storm runoff changes dry gullies and even local roads into torrents of water. As flood levels rise approaching the bay and ocean, they may spill out over low-lying areas or meet up against high tidal waters flooding coastal communities. Often associated with flooding in Marin, storm runoff may also liquify soil creating highly destructive mud and land slides (these are covered in more detail under geologic hazards).

Major watercourses posing flood problems in unincorporated Marin County include Arroyo San Jose, Corte Madera Creek, Corte Madera del Presidio Creek, Coyote Creek, Crest Marin Creek, Eskoot Creek, Lagunitas Creek, Miller Creek, Novato Creek, Olema Creek, Reed Creek, San Antonio Creek, Sutton-Manor Creek, Tennessee Creek, Walker Creek, and their tributaries. In addition to major watercourses, the County contains a number of smaller streams and watercourses which have caused considerable damage following heavy storms.

Watercourse flooding occurred in 1982, 1983, and 1986 throughout Marin County. Total damage from storms in these years ranged from 9 million dollars in 1983 and 1986 to 100 million dollars in 1982 (Marin Independent Journal, 3-4-83, 2-17-86). The extent of damage from the 1982 floods was severe, providing an impetus to improve flood control systems and establish flood plain management regulations.

"The great storm" of 1982 caused highly destructive flooding in Marin. Damage from flooding and mudslides caused four deaths, destroyed 100 and damaged 2000 homes, closed hundreds of businesses, and forced the evacuation of more than 2000 people. Flood waters and mudslides closed Highways 101 and 37, major thoroughfares, and city streets. Blocked roads completely isolated entire Marin communities for days. Sheetflow flooding and mudslides damaged many homes in hilly areas. Overflowing streams turned streets in San Rafael, San Anselmo, Fairfax, Ross, and Kentfield into raging rivers that filled business districts with as much as five feet of water. Flood waters swept away automobiles and furniture in urban areas and livestock in West Marin. County officials

called in the National Guard to evacuate flood victims, control flood waters, and help repair the destruction caused by the flood. Marin County was declared both a state and federal disaster area after the 1982 floods, and financial assistance was made available to flood victims, many of whom were not insured for flood loss. The storm cost an estimated 100 million dollars in damage, 90 million of which effected uninsured property owners and local governments.

B. Dam Inundation

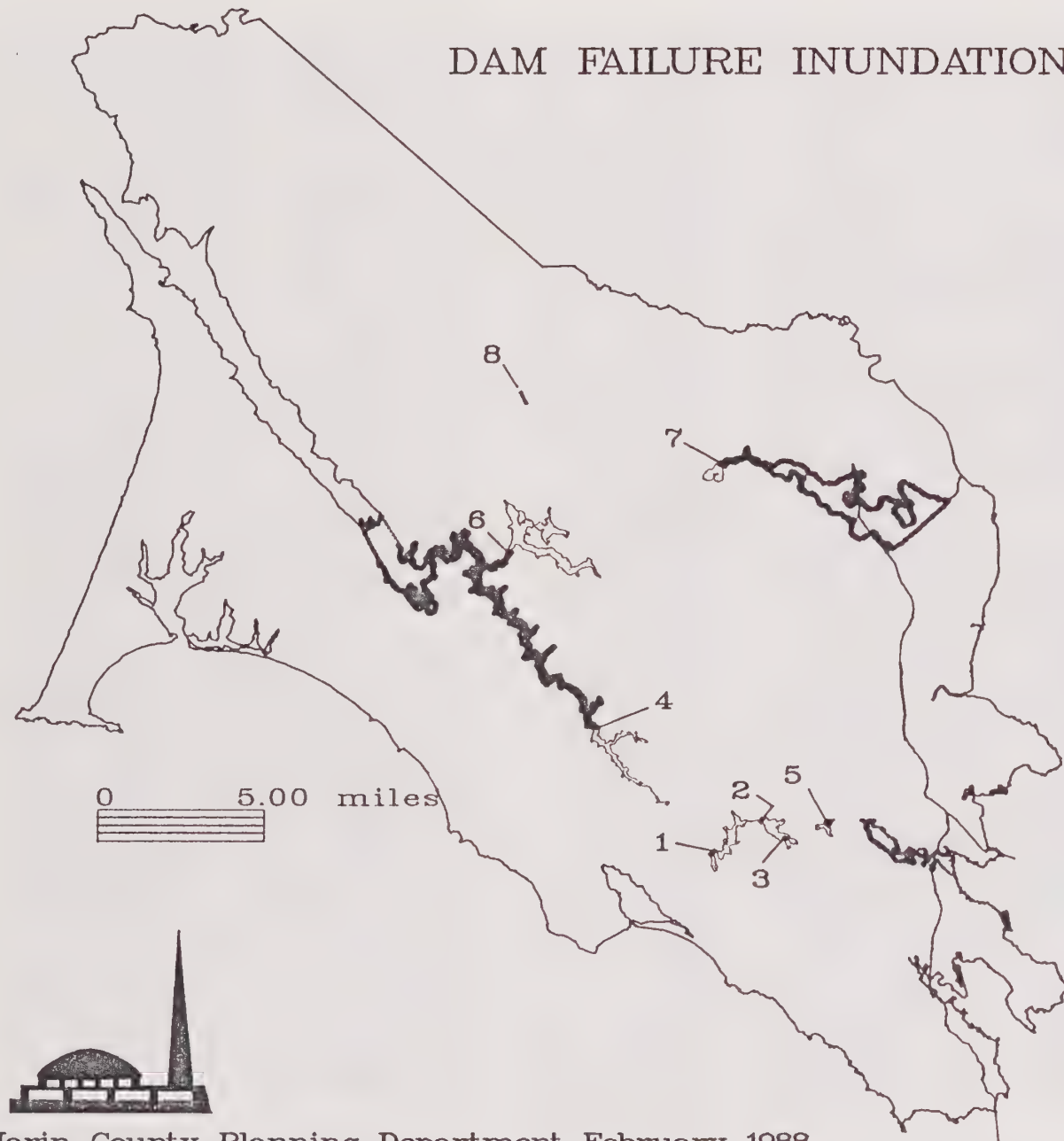
Dams in Marin County lie near the San Andreas fault and could rupture or spill water in the event of an earthquake or after a storm, causing flash flooding in populated areas. The severity of flooding would depend on the size of the quake, the amount of damage to dams, or the volume of water overtopping dam walls. A large enough quake could completely rupture dams, releasing most of the retained reservoir waters. A smaller quake, while doing little structural damage to the dam itself, could generate a seiche effect causing water to spill over dams similar to the way water spills out of a bowl when shaken. Seiche waves are generally small (less than a foot), but in shallow or constricted areas, wave run-up can be as great as 20 or 30 feet, overtopping dams and reservoirs and flooding downstream development. Heavy rains could cause overtopping as well as structural failure where water pressure could break apart weak areas in a dam wall.

Dams in the County are of two types; large facilities under public control, and small private facilities. The larger dams and reservoirs posing flood hazards include: Alpine Lake, Bon Tempe Dam, Lagunitas Lake, Kent Lake (Peters Dam), Phoenix Lake, Nicasio Reservoir, Novato Creek Dam (Stafford Lake), and SoulaJule Reservoir Dam. These dams come under the control of the State Division of Dam Safety.

Marin water districts mapped the areas subject to inundation from dam failure at seven of the eight reservoirs: Alpine, Bon Tempe, Lagunitas, Peters (Kent Lake), Nicasio, Novato Creek (Stafford Lake) and Phoenix Lake (Bon Tempe and Lagunitas were mapped along with Alpine and Peters dams). The inundation areas for SoulaJule dam, built in 1979 after the County mapping programs, have not been mapped. A dam failure at SoulaJule would inundate rural land and a Pacific Bell receiving site, endangering few populated areas. Mapped areas subject to inundation from dam failure include parts of Corte Madera, Larkspur, Inverness, Kentfield, Novato, Pt. Reyes Station, Ross, and Sir Francis Drake Boulevard from Lagunitas to Tomales Bay. The areas shown in Dam Inundation Maps represent a worst case dam failure.

Map 1, Dam Failure Inundation Areas indicates the location of large publicly maintained dams. The volume of water contained in these reservoirs is shown in **Table 3, Marin County Dams**.

DAM FAILURE INUNDATION AREAS



- 1 Alpine Dam
 - 2 Bon Tempe Dam
 - 3 Lagunitas Lake Dam
 - 4 Peters Dam
 - 5 Phoenix Lake Dam
 - 6 Nicasio Reservoir Dam
 - 7 Stafford Lake Dam
 - 8 SoulaJule Dam
- Lakes
- Dam Failure Inundation Areas



Table 3
Marin County Dams

Public Dams	Water Capacity	Responsible Water District
1. Alpine Dam	8900 acre feet	Marin Municipal Water District
2. Bon Tempe Dam	4300 acre feet	Marin Municipal Water District
3. Lagunitas Lake	390 acre feet	Marin Municipal Water District
4. Peters Dam	32900 acre feet	Marin Municipal Water District
5. Phoenix Dam	527 acre feet	Marin Municipal Water District
6. Nicasio Reservoir	10300 acre feet	Marin Municipal Water District
7. Novato Creek Dam	4230 acre feet	North Marin Water District
8. Soulajule Reservoir	10300 acre feet	Marin Municipal Water District

Source: Marin County Planning Department, 1987.

A number of small dams on private property exist in the County, primarily serving agricultural uses. Each of these dams require permits from the Department of Public Works under Marin County Code Title 11.04, Dam Construction and Repair. Areas subject to inundation from these dams have not been mapped.

Dam safety is addressed both by the State Division of Dam Safety and the Marin County Department of Public Works. The State Division of Dam Safety issues permits and conducts safety inspections for dams over twenty five feet in height and retaining over fifty acre-feet of water. The 9 large dams in Marin County fall under State jurisdiction. The County Department of Public Works, under Title 11.04, permits smaller private dams.

C. Coastal Water Floods: Ocean and Bay

The simultaneous occurrence of very high tides, large waves, storm swells, and rain during the winter may cause flooding along the Marin coast. In addition, tsunami (sea waves generated from oceanic earthquakes, marine landslides and volcanic eruptions) create potentially destructive natural water waves.

Storm centers from the southwest produce the type of storm pattern most commonly responsible for coastal water flooding in Marin. Strong southern winds accompanied by high tides and heavy surf threaten Pacific Coast and bayfront communities. In some instances, high tides back up river flows, causing flooding at river mouths.

The Pacific Coast communities most threatened by coastal water floods include Bolinas and Stinson Beach. Along the San Francisco Bay, areas

near Novato Creek, the Petaluma River, Point San Quentin, San Pablo Bay, San Pedro Peninsula, and Sausalito face significant flooding.

Severe coastal flooding occurred in 1978 and 1983 when high tides, strong winds and large storm waves severely damaged property in several Marin communities.

In January 1978, a series of storms from a more southerly direction than usual damaged normally protected ocean beaches. Waves overtopped and undermined jetties and breakwater barriers. Direct wave damage occurred to many beach front homes in Stinson Beach. Wave erosion coupled with saturated ground conditions damaged the foundations of homes in Bolinas along the ocean bluff. Seawalls and temporary barriers failed to protect property from wave damage.

In February 1983, a strong southern storm coupled with powerful winds and high tides flooded homes and businesses in San Rafael, Santa Venetia, Stinson Beach. Pounding ocean waves destroyed five homes and damaged many others in the Seadrift area of Stinson Beach. High tidal waters poured over levees in San Rafael, flooding portions of East San Rafael and the Canal area. High tides also rushed over levees in Santa Venetia flooding over 300 homes. Marin County was declared a disaster area following the 1983 storm.

Coastal floods from tsunami occur rarely along the Pacific Coast or in the San Francisco Bay. The most recent tsunami to cause any significant damage was in 1964. The 1964 tsunami caused roughly \$275,000 in damage to yacht harbors in San Rafael and Sausalito along the Bay.

D. Rise in the Sea Water Level

The projected rise in the water level of the San Francisco Bay poses a flood hazard not addressed in the 1982 Countywide Plan. In a 1985 report prepared by Philip Williams and Associates, "An Overview of the Impact of Accelerated Sea Level Rise on the San Francisco Bay", the Bay Conservation and Development Commission (BCDC) projected that a global climate change caused by the accumulation of "greenhouse" gases in the atmosphere (carbon dioxide, methane, and chlorofluorocarbons) will raise the temperature of the earth's atmosphere. BCDC claimed this global warming trend could melt polar ice caps, accelerating the rise in sea level from the present rate of one-half foot per century to an average of 4 to 8 feet in the next century.

Such a rise could effect Marin County in several ways. Tidal circulation would change and wave action would increase. Drainage would be impeded and ground water could be contaminated. Salt marsh, brackish marsh, and existing seasonal wetland areas would be reduced.

Planners at BCDC recommend that local governments take into consideration the rise in sea level in their project development, land use planning, and land use control regulatory process. Specifically, they ask local governments to study the effects of a sea level change in development project review and to apply engineering design standards to approved bayfront projects. The Commission proposes design standards and project review criteria in their report, "Sea Level Rise: Predictions and Implications for San Francisco Bay", San Francisco, December 1987. The Commission also asks that localities monitor the rise in sea level for their shoreline and identify areas at risk of increased flooding.

V. FLOOD PROTECTION MEASURES

The Marin County Departments of Emergency Services, Public Works and Planning, and the Marin County Flood Control District implement a variety of flood protection measures. These measures include a disaster plan, major flood control projects, and Marin County Code sections pertaining to flood hazards. The County also relies on FEMA maps and studies for their flood control programs.

The County's flood protection measures serve several objectives. Protection for the life and property of Marin residents against flood risks is the most basic objective, underlying all County flood protection activities. The County supports the expansion and improvement of flood control projects in order to protect existing developed communities from coastal and watercourse flooding. The County encourages regulatory methods of flood prevention for newly developing areas rather supporting the construction of costly flood control projects to meet a number of objectives:

1. Ensure that those who occupy hazard areas assume responsibility for actions which affect the general public;
2. Reduce the need for spending limited public resources on costly flood control projects that may not equally benefit all those who pay;
3. Reduce the need for rescue and relief efforts in the event of a disaster;
4. Reduce losses incurred by those inadequately protected against inevitable flooding, and;
5. Prevent avoidable risks to life and property by restricting encroachments into waterways and portions of the floodplain which are necessary for safely carrying floodwaters.

County flood protection measures also bring the County into conformance with State and Federal requirements for planning and protecting the public against the hazards associated with flooding.

A. County Disaster Planning

The Marin County Department of Emergency Services is preparing a comprehensive Disaster Plan for the County of Marin including contingency plans for flood, dam failure, and tsunami hazards. In September of 1986, the Marin County Board of Supervisors approved the first part of the plan, "Multihazard Plan, Part A, 1986" (Marin County Code 2.99, Resolution Number 86-319, 1986).

The Multihazard Plan addresses Marin County's response to extraordinary emergency situations, and focuses on large-scale disasters posing major threats to life and property. Designated Marin County officials activate the plan when they declare a State of Emergency. Emergency operations are coordinated from a central Emergency Operations Center (EOC), located in the County Administration Building. The Emergency Operations Center first became fully operational in time for the disastrous 1982 flood.

The plan also outlines emergency conditions, agencies responsible for responding to emergencies, hazard mitigation measures, mutual aid agreements, and checklists for actions required in the event of an emergency.

Parts Two and Three of the Multihazard Plan detail operations to occur in the event of a disaster and have yet to be completed by the Office of Emergency Services.

B. The Marin County Flood Control and Water Conservation District

The County Flood Control and Water Conservation District was established in 1953 by the State Legislature through the Marin County Flood Control and Water Conservation District Act (Chapter 68 of the Appendix the California Water Code). Boundaries of the District coincide with County boundaries, with the exception that the Town of Corte Madera is not part of the District. The Marin County Board of Supervisors sits as the Board of Supervisors of the Flood Control District, and the District is operated in coordination with the County Department of Public Works. The District administers flood control projects and oversees revenue collection in each of eight active Flood Control Zones in Marin. Flood Control staff work for the County of Marin, but charge their time to the appropriate Flood Zones.

Marin County Flood Control Zones are located in populated areas. Each Zone has an Advisory Board which recommends flood control projects and funding to the Board of Supervisors. Flood Control Zones raise money through property taxes and assessment overrides. The Zones fund their own control projects, and contribute funds to the central administration of the Flood Control District. The Zones vary considerably in size, financial resources, and hazard severity. Funds raised within a Flood Control Zone can only be spent within that zone. The Flood Control District has problems addressing all County flood control needs under a

system characterized by revenue surpluses in some Zones, inadequate financing for flood control projects in others, and very little money for areas outside the system of Flood Control Zones altogether. Flood Control Zones in the County are shown on Map 7, Flood Control Zones.

The Flood Control District has administered a number of flood protection measures in County Flood Control Zones. Projects include the purchase of land to reestablish the flood plain, flood proofing of property by raising flood prone buildings and making them watertight, construction of berms and retaining walls, and flood plain zoning. Other flood control activities undertaken in flood zones include the construction of physical facilities such as stream channels, pump stations, levees, and riprapping.

There are eight flood control zones in Marin, each described below.

Flood Control Zone #1 (Novato)-This Zone encompasses the entire watershed tributary to Novato Creek which includes all of the City of Novato plus a substantial amount of unincorporated area around Novato. In November of 1984, the voters of this Zone approved a four year, nine million dollar project to reduce flooding from Novato Creek and its tributaries. The Zone also periodically dredges watercourses and began an annual debris removal program in 1983 with the Marin Conservation Corps.

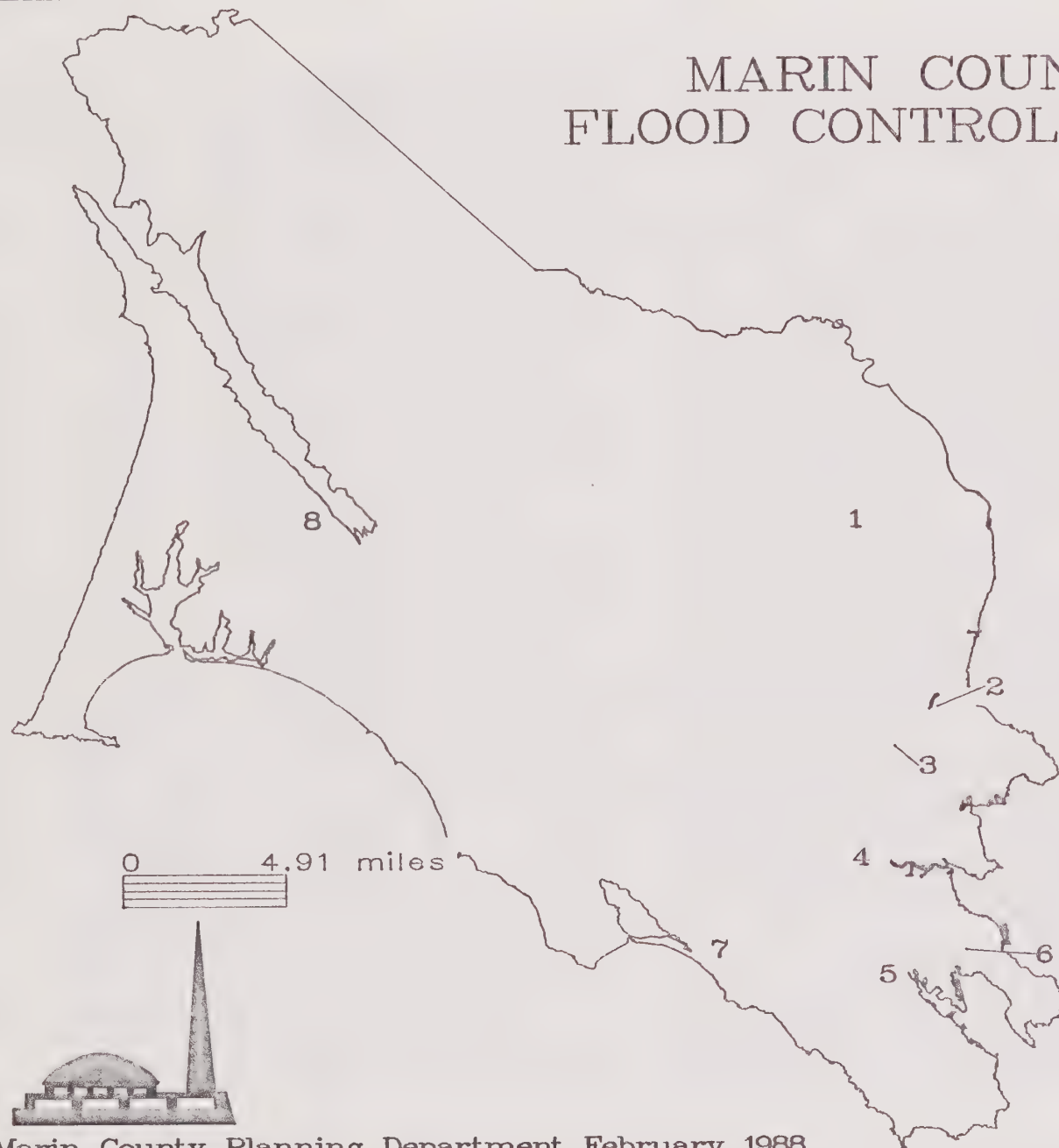
Flood Control Zone #3 (Richardson Bay)-This Zone includes the area tributary to the upper end of the Richardson Bay, all of Mill Valley, plus unincorporated areas such as Marin City, Tamalpais Valley, Homestead Valley, Alto-Sutton Manor area, and portions of the Strawberry Peninsula. The Zone has built pump stations at Cardinal Road, and Shoreline Highway at Coyote Creek. The Zone has also adopted a plan for constructing major flood control works over several years.

Flood Control Zone #4 (Bel Air)-This small Zone is located off Tiburon Boulevard, recently annexed to the City of Tiburon. The Zone maintains a major storm water pump station, cleans existing drainage ditches, and plans to replace culverts under Highway 131 and construct an additional storm water pump station.

Flood Control Zone #5 (Stinson Beach)- Flood Zone 5 includes all of the area tributary to Eskoot Creek which runs through Stinson Beach. The Zone has a very limited budget and present policy includes maintenance operations only. Periodic inspection of the creek and required enforcement of County code regarding debris and/or illegal structures occurs under the jurisdiction of the Flood Control District.

MARIN COUNTY FLOOD CONTROL ZONES

- 1 Novato
- 2 Santa Venetia
- 3 San Rafael
- 4 Ross
- 5 Richardson Bay
- 6 Belaire
- 7 Stinson Beach
- 8 Inverness



Flood Control Zone #6 (Rafael Meadows)-This Zone, located across the highway from the Marin County Civic Center, lies within the City of San Rafael. While the City of San Rafael performs all maintenance within the district, residents and the City kept the district active as a potential source of revenue for future projects.

Flood Control Zone #7 (Santa Venetia)-Flood Zone 7, located east of the Marin County Civic Center, faces a number of on-going problems related to its location in a flood plain and atop bay mud which is subsiding at the rate of one inch per year. The area was particularly hard hit during the winters of 1982 and 1983, effected both by storm water runoff and unusually high tides. The Zone began reinforcing the existing levee system after the 1982-83 floods with a loan from Flood Control Zone #4. The Zone built a bypass system to take runoff from the surrounding hill-sides and carry it into Las Gallinas Creek around local drainage systems, and a series of stormwater pump stations to lift storm water out of the area. The Flood Control District presently maintains internal drainage systems, perimeter levees and five storm water pump stations.

Flood Control Zone #9 (Ross Valley)-This Zone encompasses all of the Ross Valley with the exception of San Anselmo and Fairfax. This Zone is currently acting under court order to complete the Corte Madera Creek project. This project, though 70% completed, has been stalled for a number of years due to litigation and funding short falls. The fourth phase of the Corte Madera Creek project (in the Town of Ross) is currently under design by the Army Corps of Engineers and construction is scheduled to commence in 1988.

Flood Control Zone #10 (Inverness Ridge)-This Zone formed after a disastrous January 1982 storm. The Zone is collecting taxes and plans to clean and restore local creek channels. The Zone won a Coastal Conservancy grant for funding creek work in the Haggarty Gulch and Fish Hatchery Creeks.

C. Streamside Conservation Policy

The Countywide Plan Environmental Quality Element establishes a Streamside and Creekside Conservation Zone Policy. The Streamside Conservation Zone consists of a 50-100 foot buffer along all natural watercourses and riparian systems. The County Planning Department restricts structural improvements within the Streamside Conservation Zone for a number of reasons, such as preventing watercourse obstructions which increase flood hazards.

Appendix
2
g. 10
report
(Title 22)

D. Marin County Code Title 22-Zoning

1. Flood Plain Zoning

Marin County Code Title 22 Sections 22.94 and 22.95, adopted in 1979, establish two flood overlay zones (see Appendix 2, Title 22). The Primary Flood District (F-1) applies to lands in a primary floodway zone, defined as a channel required for the passage of flood waters. The Secondary Floodway District (F-2) applies to land between the Primary Floodway and the edge of the flood plain.

The F-1 District addresses the serious dangers associated with blockage in the floodway channel. The F-1 District prohibits the construction of buildings, structures, dredging, filling, levees or dikes within the floodway which might raise flood water levels in the F-1 District. Only portions of Novato near Bel Marin Keys have been zoned F-1.

The Secondary Floodway District (F-2) prohibits structures, buildings, leveeing, diking, or filling except within specified encroachment areas, so that each project has capacity to absorb flood water overflow from the primary floodway. The zoning district also requires the dedication of any areas zoned F-1 on the property under review to protect the public from potentially increased flood hazards which would result from the development of the flood plain in an F-2 zone. The F-2 District also allows for alternate methods of providing flood control facilities equal to original flood retention capacity. Permitted construction in the F-2 zone must comply with drainage requirements and flood control construction standards.

2. Tidelands Zoning

Marin County Code Title 22.77, Tidelands, pertains to land and water areas falling below a specified elevation (See Appendix 2, Title 22). The Tidelands Zone prohibits construction, depositing, dumping, filling, excavating, dredging and the placement of piers or other structures on tidelands. Applications may be conditionally approved as long as they meet certain conditions, including that they will not cause or increase the likelihood of flooding in adjoining lands. Rezoning pursuant to the creation of the Tidelands zoning classification include areas along the San Francisco Bay.

3. Bayfront Conservation Zones

The Bayfront Conservation Zoning overlay restricts development activity in environmentally sensitive areas along the shore of the San Francisco Bay. The Bayfront Zone enhances the County's policy of encouraging regulatory flood control by discouraging development in sensitive bay lands.

4. Coastal Zones

Marin County Coastal Zoning specifies development areas, provides for coastal access, protects natural resources, and sets standards for public and private activity in a manner consistent with the California Coastal Act (Chapter 6 Section 3). Coastal zoning governs all development in Pacific Coast communities subject to flooding. Coastal district regulations do not permit construction or significant improvements within a 100-year flood plain in a coastal zone (22.56, Development Requirements, Standards, and Conditions). The zone also specifies setbacks from the ocean for certain areas, in particular the Seadrift portion of Stinson Beach.

E. Regulation of Harbors and Waterways (Dams and Watercourses)

Marin County Code Title 11, Harbors and Waterways, regulates the construction and repair of dams and the diversion or obstruction of watercourses. Section 11.04, Dams, regulates the construction and repair of dams which are smaller than those regulated by the State of California, and states that the County Department of Public Works will periodically inspect dams in the unincorporated areas to determine their safety. Section 11.08, Watercourses, declares that the free and unobstructed flow of every creek is essential to proper drainage and the protection of life and property, and therefore any material which interferes with the unobstructed flow of water constitutes a public nuisance which must be abated.

F. Marin County Flood Plain Management

Marin County Ordinance 2710, adopted on May 11, 1982, added Chapter 23.09, Flood Plain Management (see Appendix 3, Title 23, Flood Plain Management). Marin County Code Section 23.09 (Flood Plain Management) does the following:

1. Adopts the Federal Emergency Management Agency Flood Insurance Rate Map and Floodway Boundary Map as the official flood identification maps for unincorporated Marin County.
2. Provides for the development of implementing rules and regulations.
3. Establishes a process for appeals and penalties.
4. Assigns administrative and supervisory responsibilities for the ordinance to the Department of Public Works and authorizes the Department to require compliance bonds at its discretion.
5. Requires permits for any building or construction in, upon, or over any creek, channel or watercourse.
6. Requires subdivisions to provide for grading and erosion control.
7. Adopts a zoning plan for unincorporated areas based on the County General Plan which establishes regulatory flood control zoning districts.

The Board of Supervisors adopted regulations for the Marin County Flood Plain Management Ordinance in Resolution number 82-161 "Rules and Regulations for Enforcing the Provisions of Marin County Code Chapter 23.09", on May 11, 1982 (see Appendix 4, Rules and Regulations Implementing Title 23).

Resolution Number 82-161 does the following:

1. Applies regulations to Flood Hazard Areas as shown on FEMA Flood Insurance Rate Map (FIRM) and the Flood Boundary Floodway Map.
2. Requires proposed development within a FIRM designated area to be flood-proofed through design, materials, and construction methods (such as anchoring, flood proofing lower floors, and elevations) to protect the flood-carrying capacity of any watercourse.
3. Creates a checklist for evaluating all subdivision and development applications.

4. Adopts construction standards for all new construction and substantial rehabilitation for special flood hazard areas. These standards include anchoring, construction materials and methods, elevations, flood proofing, and the storage of hazardous materials and equipment.

5. Defines Floodways as extremely hazardous areas requiring special regulatory attention including the prohibition of encroachments which may increase flood levels, and the establishment of construction standards for new construction and substantial improvement.

6. Identifies Coastal High Hazard Areas. Regulations for the Coastal High Hazard Area require structures to be sited landward of the reach of the mean high tide, prohibit mobile homes, establish construction standards and set requirements for the use of breakaway walls.

The Regulations also set out variance and appeal procedures, and standards for non-conforming uses.

G. Federal Emergency Management Agency Resources

The Federal Emergency Management Agency (FEMA), through the National Flood Insurance Program (NFIP) provides flood insurance studies and maps to localities for use in land use planning in flood hazard areas. FEMA Flood Insurance Rate Maps (FIRM) identify official flood plains (land areas likely to flood every 100 years) and base flood elevations (the expected surface elevation of a 100 year flood). The FIRM maps show elevations and flood zones. FEMA additionally supplies Floodway Maps identifying channels which must be kept free of encroachments so that the 100-year flood can be carried without substantial increases in flood heights.

The Federal Emergency Management Agency updated its 1977 flood hazard study in 1984, including a coastal analysis for the community of Stinson Beach. This study describes flood problems, flood protection measures, flood plain management and insurance issues. The study also provides basic information for Flood Plain Management in Marin County. Flood Hazard Areas identified by FEMA are shown in **Map 9, Flood Hazard areas as Identified by FEMA** (to be provided).

FEMA also conducted studies for the cities of Belvedere, Corte Madera, Fairfax, Larkspur, Mill Valley, Ross, San Anselmo, Sausalito, Novato, and San Rafael. Marin cities and towns and Marin County Water Conservation and Flood Control District Flood Zones use these studies for their flood plain planning and management.

VI. STATUS OF THE 1977 ENVIRONMENTAL HAZARDS ELEMENT

For the most part, Marin County successfully carried out the policies adopted in the 1977 Environmental Hazards Element. Flood control policies and measures enacting them are described below. The policies shown below have been somewhat abbreviated for clarity.

Policy B-3.1 No public safety structures (such as police and fire stations) should be located in areas subject to tsunamic inundation.

County Code Section 23.09 (Flood Plain Management) authorizes the creation of a Coastal High Hazard Area (Resolution Number 82-161, May 11, 1982) which restricts buildings and structures in Coastal Hazard Areas to the landward reach of the mean high tide.

Policy B-3.2 In locating public safety structures, on-site considerations should be given to the placement of persons within the range of a tsunami. Improvements should be designed to withstand impact from the tsunami and the debris it will carry.

The Flood Plain Management Regulations creating Coastal High Hazard Areas apply construction standards for structures landward of the mean high tide line, including requirements for pilings and columns, breakaway walls, and floor elevations so as to withstand "high velocity waters from coastal and tidal inundation or tsunamis".

Policy C-4.1 Consider the use of floodplain zoning

Policy C-4.2 Promote multiple uses of flood retention lands

Policy C-4.3 Encourage regulatory flood control

These three Countywide Plan Sections provide policies underlying Flood Plain Zoning (County Code Sections 22.94 and 22.95) and Flood Plain Management (County Code Section 23.09). These code sections use flood plain zoning powers to regulate flood hazards. The Flood Plain Management Ordinance allows for multiple uses of flood retention lands as long as these uses either conform to construction standards or leave floodways and primary flood floodways unobstructed.

Policy C-4.4 Consider adopting a creek setback ordinance

The County Planning Department uses the Streamside Conservation policies adopted as part of the Countywide Plan in reviewing development applications, specifying that all structures be set back from "riparian systems" including rivers, streams, and other watercourses. In 1983, Planning Department staff drafted an ordinance to codify these policies into an amendment to Title 24 of the County Code, creating creekside development standards. After hearings before the Board of Supervisors, the Board tabled the ordinance and indicated that Countywide Plan policies provided sufficient direction for implementation. The policies have

been applied to a number of development projects throughout the County.

Policy C-4.5 Reevaluate flood prone areas for changes over time

The Flood Plain Management Ordinance requires site review for all new construction and substantial rehabilitation within the flood plain. Inspections of areas within County Flood Control Zones are conducted periodically by the Department of Public Works. In addition, the Federal Emergency Management Act study published in 1986 documents changes in flood conditions in the County.

Policy C-4.6 Insure adequate stream channel capacity to handle flood runoff.

County Code Section 23.09, requires the maintenance of adequate stream channel capacity and the prevention of obstructions to stream channels through prohibitions against development within floodways. Marin County Code Titles 11 (Watercourse Obstruction), and 22 (Zoning) also prohibit activities which would reduce the capacity of stream channels to handle flood runoff.

Policy C-5.1 Dams and levees should be designed and located so as to insure dam safety

Marin County Code Section 11.04, Dam Construction and Repair, requires the Department of Public Works to inspect dams and approve applications for dam construction and repair to insure public safety.

Policy C-5.2 Property owners within areas of possible inundation be notified as to the timing and susceptibility to flood hazards.

The "Marin County Multihazard Plan, 1986", prepared by the Office of Emergency Services, provides for warning citizens of a possible dam failure. However, property owners within these areas were not notified about their susceptibility to dam failure after the adoption of the 1977 Environmental Hazards Element.

VI. PROPOSED MODIFICATIONS TO THE ENVIRONMENTAL HAZARDS ELEMENT

The following section indicates proposed policy modifications for the Environmental Hazards Element update. Policies from the 1977 Element remaining in the proposed policy statement appear in bold and plain text. Policies from the 1977 Element proposed for deletion appear in overstrike type. Newly proposed policies and implementation measures appear as underlined text.

The policies are labelled with the abbreviation of the Environmental Hazards Element (EH) and the number of that policy within the Element. Each implementation measure relates to a specific policy and is identified by the initial "I". Lower case letters indicate different implementation measures for each policy. Implementation measures from the previous element have not been shown since they formerly appeared as paragraphs of text and have been completely revised and numbered for this update.

EH-1 No structures necessary for the public safety or the provision of emergency services should be located in any area subject to inundation, unless the only alternative sites would be so distant as to thereby jeopardize the safety of the community served.

EH-1-Ia Utilize the California Environmental Quality Act environmental review procedure to review and direct the siting of public safety structures in tsunami hazard areas. EH-1-Ib Continue to implement the regulations of Marin County Code Title 23.09, Flood Plain Management, which establish Coastal High Hazard Zones with special locational and construction standards for all land uses subject to tsunamic inundation.

EH-2 In locating public safety structures, on-site consideration should be given to placement of persons within the range of a tsunami. Improvements should be designed to withstand impact from the tsunami and the debris it will carry. Those improvements which could become dislodged or detached (docks, decking, floats, vessels) should be situated so that they-do-not become-potential-implements-of- destruction do not endanger lives or property.

EH-2-I Continue enforcement of Marin County Code Sections governing subdivisions (Title 20), tidelands development (Title 22), and coastal high hazard area siting and improvements (Title 23).

EH-3 Continue to promote the multiple use of areas set aside for flood retention ponding purposes (i.e. agriculture, open

space, education, ecology), provided these uses are tolerant of occasional flooding.

EH-3-I Encourage the multiple use of ponding and encroachment areas designated under Title 23 (Flood Plain Management), and the use of lands reserved for flood plains under the Floodway Zoning provisions of Title 22 (Zoning) through the application review process.

EH-4 Encourage regulatory methods of flood control as-distinguished from-costly-methods such as development standards which reduce the need for flood control projects as well as rescue and relief efforts, reduce losses by those who could not be adequately protected against inevitable flooding, and ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

EH-4-Ia Continue to support and enforce special flood hazard zones including the Streamside Conservation Policy(Countywide Plan Environmental Quality Element), the Coastal High Hazard Zone (Title 23, Flood Plain Management), and the Bayfront, Flood Plain, Tidelands, and Coastal Zones.

EH-4-Ib Strengthen and clarify references to flood hazard areas occurring along the San Francisco Bay, Tomales Bay, and the Pacific Ocean in the zoning ordinance sections pertaining to the Bayfront Conservation Zone, the Coastal Zone, the Planned District Zones, and the Tidelands Zone.

EH-4-Ic Enforce the inundated area provisions of subdivision, planned district, and tidelands ordinances included in Title 20 (Subdivisions) and Title 22 (Zoning).

EH-4-Id Refer all permit applications for proposed construction, substantial improvements and other development to the Department of Public Works to determine whether development is proposed within flood prone areas and therefore subject to the provisions of Title 23.09, Flood Plain Management.

EH-4-Ie Enforce the special locational, storage, water supply and sewer, subdivision, and mobile home standards for flood hazard areas identified in Title 23 restricting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in increases in erosion or in flood heights or velocities.

EH-4-If Require that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction by applying the

construction standards of the Marin County Code, including Title 23, Flood Plain Management.

EH-4-Ig Support special restrictions in floodways and watercourses due to the extreme hazards posed by floodway development which can increase the risks associated with the velocity of flood waters carrying debris, potential projectiles, and erosion potential. This includes prohibiting encroachments in watercourses, prohibiting structures within a primary floodway, and restricting building in a secondary floodway or flood fringe which would increase risks to public health and safety in the event of a flood. These restrictions are specified in Title 11 (Watercourse Obstruction), Title 22 (Flood Plain Districts), and Title 23 (Flood Plain Management). These restrictions are implied in the Streamside Conservation Policy.

EH-5 ~~Consider~~Expand the use of flood plain zoning overlays in flood areas to minimize flooding hazards.

EH-5-Ia Consider expanding the flood plain areas covered by the F-1 and F-2 zoning districts.

EH-6 ~~Insure adequate capacity to handle anticipated flood runoff in stream channels by restricting development, storing, ponding, or maintenance dredging in preference to concrete channelization.~~ Control filling, grading, dredging, and other development which may increase flood damage by increasing sedimentation in streams and watercourses and increasing the amount of impervious surface in an area.

EH-6-Ia Enforce the provisions of Titles 11, 19, 20, 22 and 23 regarding grading, excavation, filling, and dredging.

EH-6-Ib Require detailed hydrology and geologic studies in development projects which have the potential for increasing sedimentation of watercourses, increasing impervious surface, or altering natural drainage patterns so as to insure adequate capacity to handle flood runoff safely.

EH-7 Prevent the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas.

EH-7-Ia Enforce the provisions of the Streamside Conservation policies of the Countywide Plan Environmental Hazards Element.

EH-7-Ib Enforce the relevant provisions of Titles 11 (Water-course Diversion and Obstruction), Title 22 (Zoning), and Title 23 (Grading, Excavating, Filling, and Flood Plain Management).

EH-8 Consider-adopting-an-implementable-creek-setback-ordinance- to reduce-flood-damage-and-protect-creek-environments-in-conjunction-with-the-acquisition-of-drainage-easements-

EH-9 Re-evaluate flood prone areas periodically regarding changes to elevations as a result of off-site development or natural forces

EH-9-Ia Enforce the Tidelands (Title 22.77), Excavation, Grading and Filling (Title 23.08) and Floodplain Management (Title 23.09) sections of the Marin County Code requiring inspections and studies for new development and substantial improvement in flood prone areas.

EH-10 Dams and levees should be designed and located to insure safety from all maximum credible potential seismic events.

EH-10-Ia Continue to enforce the provisions of Titles 11.04 (Dams), 23.08 (Excavation) which allows the County to review applications for dam permits where dam size is below that requiring a permit from the State of California.

EH-10-Ib Continue to inspect existing levees and review new levees for seismic safety.

EH-11 Property owners within areas of possible inundation due to dam failure should be notified regarding timing and susceptibility to flood hazard.

EH-11-Ia Make available to the public information regarding the location of dam inundation areas.

EH-12 Evaluate the potential for a rise in the level of the ocean and bay and develop a program for integrating information about such a rise into the on-going flood control planning efforts of the County.

EH-12-Ia Work with the County Flood Control and Water Conservation District and the Department of Public Works to prepare potential responses to a rise in the sea level. Consider the development of flood control projects and the modification of Marin County Code Chapters 11, 22, and 23 regarding construction standards for areas subject to increased flooding due to a rise in the sea level.

EH-12-Ic Establish monitoring stations to track the rise in
Bay water levels.

Appendix A. Detailed Maps of Marin County Dam Inundation Areas

Inundation from Dam Failure-Alpine and Peters (Part One)



Inundation from Dam Failure-Alpine and Peters (Part Two)



Inundation from Dam Failure-Phoenix Lake

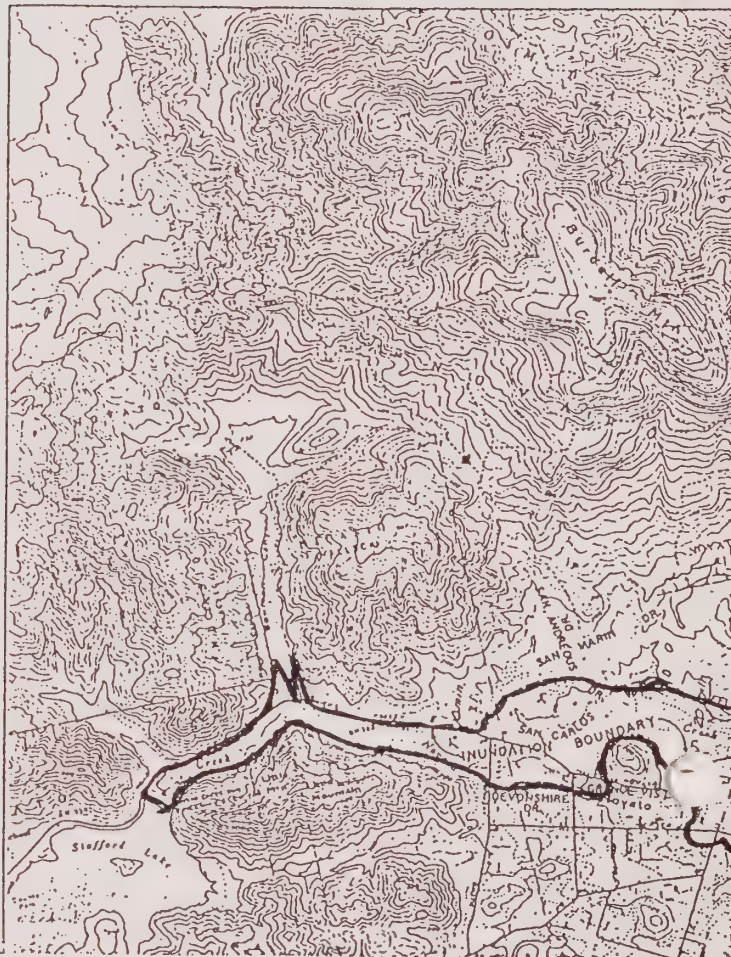


Inundation from Dam Failure-Nicasio Dam



REVISIONS BY: _____ DATE: _____ ACCEPTANCE BY: _____ DATE: _____		OWNER: MAHIN MUNICIPAL WATER DIST ADDRESS: 220 NELLEN AVE CORTE MADERA, CA 94925 DATE: NOV 1974 NEXT REVIEW DATE: _____		ENGINEERING ANALYSIS BY: NAME: MARIN MUNICIPAL WATER DIST ADDRESS: 220 NELLEN AVE CORTE MADERA, CA 94925 SIGNATURE: <i>Carl A. Baumstieger</i> REG. CIV. ENG. NO. 20361	
--	--	---	--	---	--

INUNDATION MAP
OF
NICASIO DAM



legend

- stafford dam inundation
- - - areas subject to inundation if rupture occurs
- area of heaviest inundation 3-5'
- - - 10 minutes from dam rupture to time of inundation

newest mud in consultation and north main water district, 1975

10 0 100 200 300 400 500 600 700 800 900 1000

0 1 2 3 4 5 6 7 8 9 10

stafford dam inundation

map 36

Inundation from Dam Failure- Novato Creek Dam and Stafford Lake



INUNDATION MAP OF NOVATO CREEK DAM

ENGINEERING ANALYSIS BY
 NAME THE MURRAY JACOBSEN
 ADDRESS ENVIRONMENTAL GROUP
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 OAKLAND, CALIFORNIA 94621
 SIGNATURE *James E. Murray*
 REG. CIV. ENG. NO. RCE 11149

OWNER NORTH MARIN COUNTY WATER DISTRICT
 ADDRESS 333 ATHERTON AVENUE
 NOVATO, CALIFORNIA 94947
 DATE 1973
 NEXT REVIEW DATE

REVISIONS	DATE	ACCEPTANCE BY	DATE

Appendix B References

The Ark, January 13, 1982.

Coastal Post, January 18, 1982.

Federal Emergency Management Agency. "Flood Insurance Policy Claims Payments by Year of Payment and Year of Flood for State of California." May 3, 1987.

Federal Emergency Management Agency. Flood Insurance Rate Maps and Floodway Boundaries. 1982, 1986.

Federal Emergency Management Agency. Flood Insurance Study: Marin County, California, Unincorporated Areas. Community Number 060173. November 1981.

Marin County Department of Emergency Services, Multihazard Plan. 1986.

Marin County. Marin County Code. 1986.

Marin County Planning Department. Countywide Plan. 1982.

Marin County Planning Department. Environmental Hazards Element: Appendices. 1977.

Marin County. Rules and Regulations for Enforcing the Provisions of Marin County Code Chapter 23.09. 1982

Marin Independent Journal. January 5-17, 1982.

Marin Independent Journal. March 4, 1983.

Marin Municipal Water District. A Reference Guide. May, 1982

Marin Municipal Water District. Inundation Map of Alpine and Peters Dams. 1974.

Marin Municipal Water District. Inundation Map of Nicasio Dam. 1974.

Marin Municipal Water District. Inundation Map of Phoenix Lake. 1974.

Moffatt and Nichol. Future Sea Level Rise: Predictions and Implications for San Francisco Bay. San Francisco: Bay Con-

servation and Development Commission, 1987.

News Pointer. January 6, 1982.

North Marin Water District. Inundation Map of Novato Creek Dam. 1973.

Pacific Sun. January 8-21, 1982.

Point Reyes Light. January 14, 1982.

State of California. Government Code. Sections 65302, 66434. 1986.

State of California. Water Code. Section 6002. 1986.

Williams, Philip and Associates. An Overview of the Impact of Accelerated Sea Level Rise on San Francisco Bay. Bay Conservation and Development Commission, December 1985.

Appendix C
List of People and Agencies Contacted

Carl Baumsteiger, Marin Municipal Water District.

Jeff Blanchfield, Bay Conservation and Development Commission.

Richard Carlsen, Flood Control Engineer, Marin County Department of Public Works.

David Cobb, Federal Emergency Management Agency.

Bill Doyle, Marin County Department of Emergency Services.

Scott Hochstrasser, Principal Planner, Marin County Planning Department.

Chuck Murphy, Marin County Department of Public Works.

North Marin Water District

David Zaketi, California Department of Emergency Services.

~~Robert M. Hays~~
DRAFT

ENVIRONMENTAL HAZARDS ELEMENT
TECHNICAL REPORT #2 (FIRE)
FIRE HAZARDS: EXISTING CONDITIONS

MARIN COUNTY PLANNING DEPARTMENT
Room 308 Civic Center
San Rafael, CA 94903

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Tom Giudice, Planning Intern

DRAFT DOCUMENT AS OF MAY, 1988

I. EXECUTIVE SUMMARY

The Board of Supervisors adopted the current Environmental Hazards Element of the Marin Countywide Plan in 1977; it contains policies to address fire hazards in the County. Since then, the legal, environmental and programmatic conditions for fire hazard planning have changed significantly. This report recommends updates to adopted County policy and codes to address these concerns.

Fire Hazards

Fire hazards in Marin County which threaten lives, property, and the natural environment fall into two general categories: wildland fires and structural fires.

1. Wildland Fires

Marin forest and chaparral areas containing old and highly flammable vegetation have been prevented from burning naturally for as long as 40 years. Many Marin homes face increased risks due to steep slopes, narrow streets, flammable roofing materials and too great a distance from fire stations.

Wildland fires from 1977 to 1984 have burned only 2,000 acres, a low burn rate when compared to natural burns documented in the area since 1859. Ironically, effective fire suppression techniques have increased the likelihood of future uncontrollable wildland fires by allowing the accumulation of ever larger proportions of highly flammable plant materials. Recent studies of the Mt. Tamalpais watershed and the Novato area predict that fires in these areas could cause millions of dollars in private property loss, and cost millions more to suppress.

Residential development patterns in Marin increase the likelihood that homes will be destroyed as they are frequently located on steep slopes, poorly addressed and accessible only by narrow roads. Hill homes may have decks, and pole supports which serve to trap heat and wood shingle roofs which catch fire rapidly; and they are frequently surrounded by highly flammable vegetation.

Studies of fires in similarly developed areas (e.g. Los Altos Hills, 1985 and Brentwood/Bel-Air, 1985) show that 66% of destroyed homes had wood shingle roofs and were first ignited on the roof. Some 70% of the destroyed dwellings were located within 50 feet of chaparral and 45% of all stilted or cantilevered homes were destroyed.

2. Structural Fires

From 1978 to 1986 there were over 3,000 structural fires in Marin resulting in over \$31 million in losses, 179 injuries and 16 deaths.

A 1987 survey of fire departments in the county revealed a preponderance of conditions which increase the risk of loss in unincorporated areas including 1) delayed emergency response time to the scene of a fire, 2) inadequate road access and 3) poor water supply.

Within the first five minutes of a fire, temperatures can reach 1000 degrees Fahrenheit, high enough to instantly ignite most interior materials. This is why fires outside the five minute response time have caused greater damage.

Fire Protection

Sixteen fire protection districts serve the various communities in Marin County including some unincorporated areas. Most have mutual aid agreements with neighboring districts to assist with major fires. The State of California also contracts with the County of Marin to provide fire service outside the city boundaries in the so-called "State Responsibility Area".

Fire protection services include a variety of programs and special regulations designed to prevent fires from occurring such as public education, landscape management and special construction standards. The application of fire safety construction standards is uneven within unincorporated areas however, because the County's existing building fire safety codes are not as strict as many of the fire districts' and cities'.

Fire districts are typically asked to comment on a development project which requires a discretionary permit from County Planning. Frequently, the district's building standards are made a condition of project approval. Many building permits, however, which do not require additional permits from County Planning, thus escape the fire district's stricter standards.

Fire Hazard Planning

The County has taken the first step to address major fire disasters by adopting the Multi-Hazard Plan. This plan is a checklist for action for evacuation, communications, mutual aid and so forth in the event of a major fire disaster.

However, the County's building and subdivision codes do not sufficiently protect the ordinary home from a smaller but far more likely event. The policies and implementation program proposed for amendment to the Environmental Hazards Element of the general plan call for: 1) code amendments to require Class-C fire retardant roofing, 2) automatic sprinklers in areas outside of the 5-minute response time and 3) support for environmentally sound controlled burns to reduce unnatural buildup of old and hazardous vegetation.

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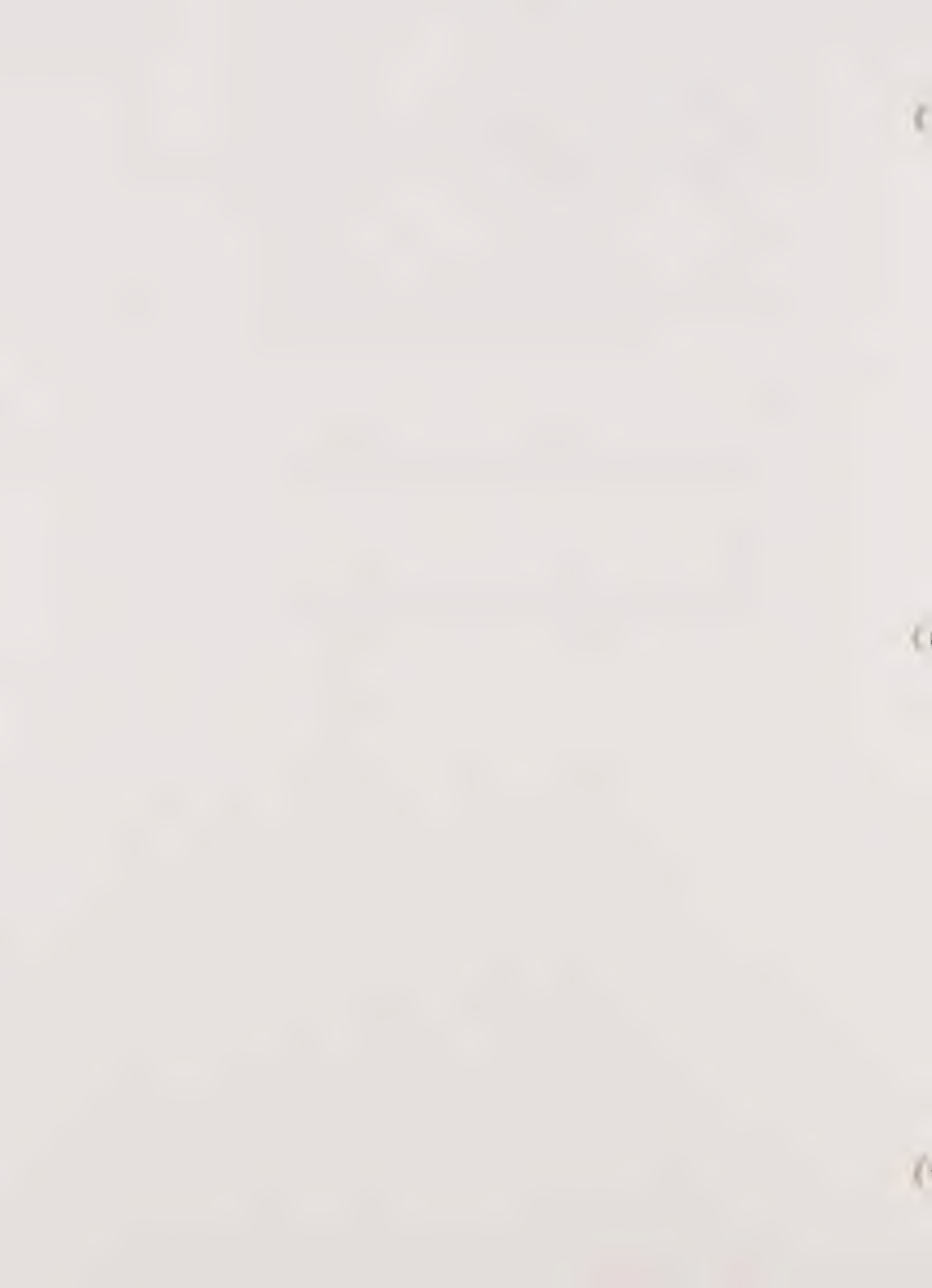
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ENVIRONMENTAL HAZARDS ELEMENT
TECHNICAL REPORT #2
FIRE HAZARDS

II. PURPOSE

The Marin County Board of Supervisors adopted the current fire hazards component of the Marin Countywide Plan Environmental Hazards Element in 1977. Over the last eleven years the legal, environmental and programmatic conditions for fire hazard planning have changed, necessitating modifications to the 1977 policies. This technical report documents existing fire hazard conditions in Marin County and recommends amendments to update the policies of the Environmental Hazards Element.

III. AUTHORITY FOR FIRE HAZARD PLANNING

The California Health and Safety, Government, and Public Resources Codes provide the legislative authority for fire hazard planning in California cities and counties. The California Government Code requires local governments to incorporate a fire hazards section into their local general plans and implementing ordinances. The Health and Safety Code establishes fire hazard severity zones with fire prevention regulations enforced by local governments. The Public Resources Code establishes enforcement authority for local governments requiring brush clearance in their areas.

California Government Code Section 65302 requires local governments to prepare a General Plan Safety Element which includes the identification of evacuation routes, peak load water supply requirements, minimum road widths, and clearances around structures. Section 65303 of the Government Code requires the naming of streets and numbering of houses to assist in the identification of burning structures. Section 65451 requires subdivision plans to include building density and water supply availability which can be critical in minimizing fire risks. Section 66479 also provides local governments with the authority to require the dedication of lands for fire stations, subject to certain enumerated conditions.

California Health and Safety Code Section 13108.5 establishes hazardous fires zones for state and privately owned rural and wildland areas designated by the State Board of Forestry as State Responsibility Areas. The State Fire Marshall rates fire hazard zones according to the severity of fire hazards. The State Fire Marshall applies special construction standards, including a requirement for fire retardant roofs, to fire hazard zones around the State. The State may contract with local fire authorities to provide services within State Responsibility Areas, as they do in Marin County.

California Public Resources Code Section 4291 provides enforcement mechanisms for local governments to require brush clearance as a fire safety precaution. Proposed amendments to the Public Resources Code recently proposed by State Senate Bill 1075, approved by the Governor on September 21, 1987, propose amendments to Section 4290 of the Public Resources Code to create additional fire safety regulations for clearance around structures (see Appendix B).

IV. FIRE PROBLEMS IN MARIN COUNTY

A. Overview of Marin County Fire Hazards

Fire hazards in Marin County threaten lives, property, and the natural environment. Prevented from burning naturally for as long as 40 years, Marin forest and chaparral areas contain old and highly flammable vegetation posing significant hazards to scenic environments and residential communities. Many Marin homes face increased fire risks due to steep slopes, narrow streets, flammable roofing materials, proximity to old and overgrown vegetation, and distance from fire stations.

Fire hazards in the County fall into two general categories: wildland fires which emanate from open chaparral, grassland or forest areas and can threaten adjacent residential communities; and structural fires which damage the home or the work place of origin and may spread to other areas. These two categories are discussed separately below.

B. Wildland Fires

Vegetation, weather, topography, and the location of built areas on the edge of wildlands create wildland fire hazards in Marin County. Marin forest, chaparral and grassland areas include a build-up of dry, dead vegetation which provides abundant and highly flammable fuel for wildfires. Hot, dry Marin summers reduce plant moisture and make vegetation more susceptible to burning. Unpredictable winds near the ocean, along ridge lines

and in steep drainages spread wildland fires quickly and erratically by changing fire direction and speed. Steep Marin slopes allow lowland fires to preheat vegetation before climbing hill-sides, increasing the rate of fire spread and impeding fire-fighter access. Many Marin communities located in the urban fringe face risks in the event of a wildfire. These risks are increased by flammable building materials, stilt and pole construction along steep slopes, poor road access, confusing street addresses, and dense vegetation immediately surrounding homes near the wildland.

A major wildfire in Marin would cause significant damage to open areas and private property. Wildland fires in Marin from 1977 to 1984 burned over 2,000 acres in 538 fires according to the California Department of Forestry. (See Table 1.)

Table 1. Wildland Fires in Marin from 1977 to 1984.

Year	Number of Fires	Number of Acres Burned
1977	53	56
1978	64	181
1979	70	302
1980	113	293
1981	61	579
1982	49	346
1983	62	156
1984	66	975
-----	-----	-----
TOTALS	538 Fires	2,888 Acres Burned

Source: California Department of Forestry, 1987.

A study conducted in 1984, An Assessment of Wildland Fire Potential in the City of Mill Valley and the Tamalpais Fire Protection District, (Donald Perry, 1984), predicted that a major Mt. Tamalpais fire could cause millions of dollars in private property loss and burn as many as 5,000 acres of scenic open area.

A similar study conducted for the Novato area, Fuels, Environmental, and Fire Behavior Associated with the Wildland Urban Interface of Novato, CA, (Donald Perry, 1983), suggested that a wildland fire in the Novato area could result in damage similar to that caused by a 1981 Napa fire which burned 61 homes, caused and cost close to \$36 million in damage, and cost over \$1.5 million to suppress.

The risk of fire loss in Marin depends on vegetation, weather, topographical and residential development conditions which increase the risk of loss in the event of a wildfire.

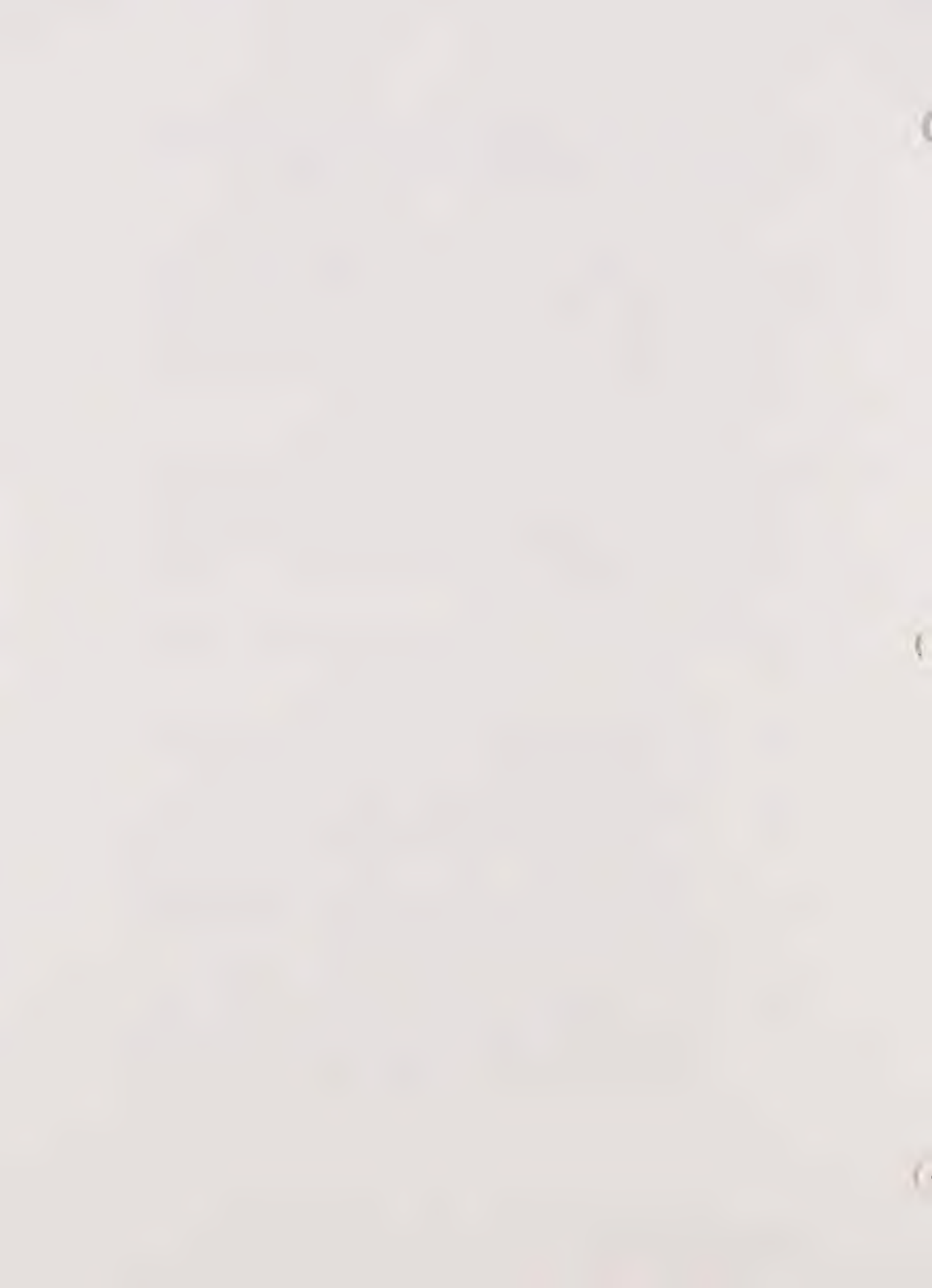
1. Vegetation

Wildland fires occurred naturally in Marin County for hundreds of years before the advent of effective fire suppression. Ignited by lightning and humans, these fires cleared accumulated vegetation and regenerated plant communities. Both forests and chaparral required periodic fires to aid mineral recycling of the soil by returning debris to ash, creating better areas for animals to feed, and regenerating trees and shrubs. Some species of Marin plants only germinate following a fire.

Major forest fires occurred in Marin every 20-30 years and chaparral fires more frequently according to a study of fires in Muir Woods ("Fire History and Perpetuation of Natural Coast Redwood Ecosystems", Journal of Forestry, Vol. 83, No. 8, August 1985). Over thirteen fires occurred in the Mt. Tamalpais watershed between 1859 and 1945, averaging once every ten years over this period (See Figure 1). Since 1945 there have been no major fires in the Tamalpais watershed.

Figure 1. Partial History of the Watershed Area of Tamalpais
1859 to 1945

1859	Fire burns on Mt. Tamalpais for 3 months.
1881	Bill Williams Gulch Fire: 10 miles long, 6000 acres. Pixley Fire: Baltimore to Blithedale Canyon towards Corte Madera. 50,000 acres burned.
1891	Fires burn from Eldridge Grade over much of the north side of Tamalpais including Bill Williams Gulch.
1895	Fire in Bill Williams Gulch spreads over east and west sides of the canyon. Fire eventually controlled by fire fighters.
1899	Fire on south side of Tamalpais spreads to Corte Madera Gulch, Boyle Canyon, Blithedale Canyon, and Cascade Canyon. Several structures burned.
1905	Fire from Bolinas area burns east and west sides of Bolinas Ridge.
1906	Fire on north end of Bolinas Ridge.
1913	Fire on Mt. Tamalpais south slopes burns area from Kent Woodlands to Muir Woods. 2000 men on fire line. Mill Valley residents fight fire from their homes. Fire burned for 10 days before controlled.



- 1916 300 men fight fire on south slope of Mt. Tamalpais.
Fire burned for 2 days.
- 1923 Largest fire in recorded Marin history. Area from Ignacio to Woodacre burned where 30 to 40 homes were lost. Fire proceeded to the base of Tamalpais, west to Bolinas Ridge then east towards Mill Valley. Rain eventually controlled blaze. A 100 square mile area burned.
- 1929 Fire burns 1000 acres and 100 homes in Mill Valley including area from Blithedale to Throckmorton Ridge to West Point. 2000 to 3000 fire fighters on the line.
- 1945 Last large watershed fire burned area from Kent Lake to south edge of Bolinas Ridge up to the west summit of Tamalpais and to the Cascades in Fairfax.

Source: Marin County Fire Department, 1986.

The relatively recent and effective suppression of fires has interrupted natural cycles of burning and rejuvenation in Marin plant communities. This has allowed a hazardous build-up of plant material and changed the composition of plant communities, permitting the invasion of scrub, non-native plants, and species not tolerant of occasional burning.

Fire suppression has allowed chaparral in the County to age and become a volatile fire fuel. Chaparral becomes highly flammable after 20 years of uninterrupted growth. Much of the vegetation in Marin wildlands exceeds 20 years of age. Vegetation age in Novato and Mt. Tamalpais communities is documented on Table 2 on the next page.

Ironically, fire suppression efforts increase the likelihood of significant damage from eventual wildland fires by allowing the accumulation of vegetation with an ever larger proportion of highly flammable dead and dry plant material. According to a report prepared by the Marin County Open Space District, ("Controlled Burns on District Open Space Lands", November 4, 1986) a summertime fire on Mt. Tamalpais has the likelihood of being uncontrollable given existing dead vegetation buildup on Mt. Tamalpais.

Table 2. Age of Vegetation in Portions of Marin County

Novato Area

Big Rock Ridge	28 to 31 years
Burnt Ridge	28 to 32 years
Indian Valley	28 to 32 years
Wild Horse Valley	26 years
Bahia	24 to 28 years

Mt. Tamalpais Area

Warner Canyon	25-30 years
Blithedale Ridge	28-40 years
Fern Canyon	30 years
Tennessee Valley	30 years

Source: Donald Perry, Fuels, Environmental, and Fire Behavior Factors Associated with Wildland Urban Interface of Novato, California, 1983; and An assessment of Wildland Fire Potential in the City of Mill Valley and the Tamalpais Fire Protection District, 1984.

The buildup of older plant material over time increases the heat output and rate of spread of an eventual wildland fire. In Marin chaparral vegetation, such as that present in the Novato, Mt. Tamalpais and West Marin areas, the existing accumulation of plant fuel will increase heat from eventual wildland fires: making them more destructive to plant and animal life and placing larger areas of land at risk.

A major wildland fire in Marin could cause severe damage to open space and park lands. Fire fighting efforts require bulldozing, road cutting and the use of fire retardant chemicals which would scar the land. Rainfall following a major fire would cause severe erosion, landslides and mudslides, further disrupting plant renewal by displacing top soil and possibly endangering roads and homes.

A major wildland fire would also threaten residences located near forest, brush, or grassland areas. Many Marin homes are located in semi-rural areas surrounded by trees and brush. This dry natural cover can set a home on fire in the event of a major wildland fire or can rapidly spread a residential fire to surrounding areas.

2. Weather

Seasonal climate conditions contribute to Marin fire hazards. Air temperature and relative humidity affect fuel moisture, suppressing fires during much of the year and encouraging fire spread during the summer and early fall. Winds provide the driving force to a spreading wildfire. Erratic changes in wind speed and direction characteristic of the San Francisco Bay Area produce unpredictable fire patterns in Marin County. In the Tamalpais area, the marine influences of the San Francisco Bay and the Pacific Ocean maintain moisture levels which discourage wildland fires yet create erratic winds which can spread wildfires rapidly. (Perry, 1984).

3. Topography

Marin's diverse topography affects fire conditions in each area of the County. Areas with steep slopes face greater fire risks. The rate of fire spread roughly doubles as the slope percentage doubles, since wind drafts on slopes preheat vegetation allowing fires to move more rapidly.

Marin slopes may be as steep as a 70% grade, as in Fern and Cascade Canyons near Mt. Tamalpais. Many areas are virtually inaccessible to fire safety personnel due to the narrow width of fire roads and the dense vegetation surrounding them. Slope conditions following a fire/flood sequence would produce major mudslides in Fern and Cascade Canyons, Blithedale Ridge, and Homestead Valley (Perry, 1984).

Steep and broken terrain creates wind eddies, or erratic wind flows, making fire behavior erratic and more difficult to combat in the County, particularly near Novato. Winds on Big Rock Ridge, Burnt Ridge, and Burdell Mountain pose significant problems for fire fighters (Perry, 1983).

4. Patterns of Residential Development

Residential development patterns in Marin increase the likelihood that homes will be destroyed in the event of a wildland fire. Many Marin homes are located on the fringe of wildland and brush areas. These homes may be located on steep slopes, accessible only by narrow roads which are poorly addressed. Hill homes may have decks or pole supports which leave large floor areas suspended to trap heat, increasing opportunities to ignite the home. Homes in Marin County wildland areas commonly have wood shingle roofs which catch fire rapidly. Homes are often surrounded by highly flammable vegetation facilitating the spread of wildfires into residential areas.

The role of residential development patterns in increasing the costs of a fire are illustrated in examples of wildland fires which have attacked California communities unexpectedly. The July 1985 Los Altos Hills fire which burned 150 acres, destroyed 12 homes, injured 10 fire fighters, and caused an estimated 9 million dollars in damage occurred in a Northern California community not far from Marin. Much of the damage caused by the blaze was attributed to hazardous residential development patterns. A study conducted by a Los Altos task force found that the presence of uncleared brush and grasses near homes, the preponderance of wood shake roofs, and failure to adequately maintain fire roads all contributed to disaster losses.

Similar conclusions were drawn by The National Foundation for Environmental Safety Newsletter which described the 1985 Brentwood/Bel-Air wildland fire that destroyed 484 homes. The study identified the following patterns in the coastal Bel-Air community fire.

1. 75% of the buildings destroyed had wood shingle roofs
2. 66% of all dwellings which sustained any damage were first ignited on the roof.
3. 70% of all dwellings destroyed were located within 50 feet of chaparral.
4. 45% of all stilted or cantilevered homes were destroyed.
5. With a 100 foot brush clearance, homes with a wooden roof had a 21 times greater chance of burning than homes with non-wood roofs.
6. Natural or man-made barriers such as firebreaks were incapable of interrupting the forward progress of fire burning in old age chaparral under severe fire weather conditions.

The conditions which contributed to the Los Altos Hills and Bel Aire fires exist presently in Marin County.

A Planning Department survey of Marin County Fire Departments conducted between June and October of 1987 identified 1) poor access, 2) the presence of wood shake roofs in many areas, and 3) lack of brush clearance around structures as the most serious wildland fire hazards facing several different Fire Protection Authorities around the County. Fire District officials in Marinwood, Ross Valley, and the County Fire Protection District in particular identified the prevalence of wood roofs as a significant fire hazard in their districts.

The 1984 Perry study of the Mt. Tamalpais area identified the following wildland/urban interface fire hazards specific to the Tamalpais area:

1. Narrow/winding roads are surrounded by dense overhanging vegetation which impede firefighter access.
2. Minimal water pressure flows.
3. Poor addressing in much of the area.
4. Homes in the area are primarily wood construction with wood shake roofs. Many homes are located on sloping hills with wood deck overhangs which are extremely dry due to decades of exposure. Brush and trees closely surround homes.

The 1983 Perry study of the Novato area also found residential development patterns which increase the risk of serious losses in the event of a brush fire. A majority of the homes in the Bahia, Blackpoint, Greenpoint, Indian Valley, and Wild Horse Valley areas are wood construction with shake roofs and little brush clearance. Some of these areas are difficult to reach due to narrow, winding roads and distance from fire stations.

C. STRUCTURAL FIRES

All buildings including homes, businesses, and recreational facilities face structural fire risks. The risk of damage to homes and businesses from fire is in part determined by the adequacy of road access, length of time required for fire fighters to arrive at the site, and the availability of adequate water supply. Current roadway, and water supply conditions contribute to the level of structural fire risk in Marin County.

Table 3. Structural Fire Incidence in Marin County: 1978-1986.

Year	Number Fires	Structure Loss in \$	Content Loss in \$	Fire Fighter Injuries/Deaths		Civilian Injuries/Deaths	
1978	353	1,652,010	818,145	13	1	15	2
1979	445	3,320,661	1,100,811	14	0	9	4
1980	390	2,309,820	632,070	8	0	13	0
1981	365	2,473,685	1,751,841	6	0	10	3
1982	347	1,994,391	1,054,375	20	0	6	2
1983	266	2,482,086	1,156,152	9	0	5	2
1984	290	3,741,695	1,977,751	10	0	6	2
1985	303	2,031,930	525,221	5	0	10	0
1986	320	3,206,299	935,355	11	0	9	1
TOTAL	3077	23,212,577	9,951,721	96	1	83	16

Source: California State Department of Forestry, 1987

Structural fires in Marin between 1978 and 1986 caused \$23 million in structural and \$10 million in content damage to homes in the County. These fires also injured 179 people and caused 16 deaths (see Table 3.).

The lack of adequate water supply for fire fighting, poor access to structures, and delayed emergency response may increase fire losses from fires such as these. A survey of fire departments in the County, conducted from July to September of 1987, revealed the presence of conditions which increase the risk of losses from structural fires in Marin unincorporated areas. Existing conditions contributing to risk of loss in Marin structural fires include: 1) response time to the scene of a fire, 2) inadequate road access, and 3) poor water supply.

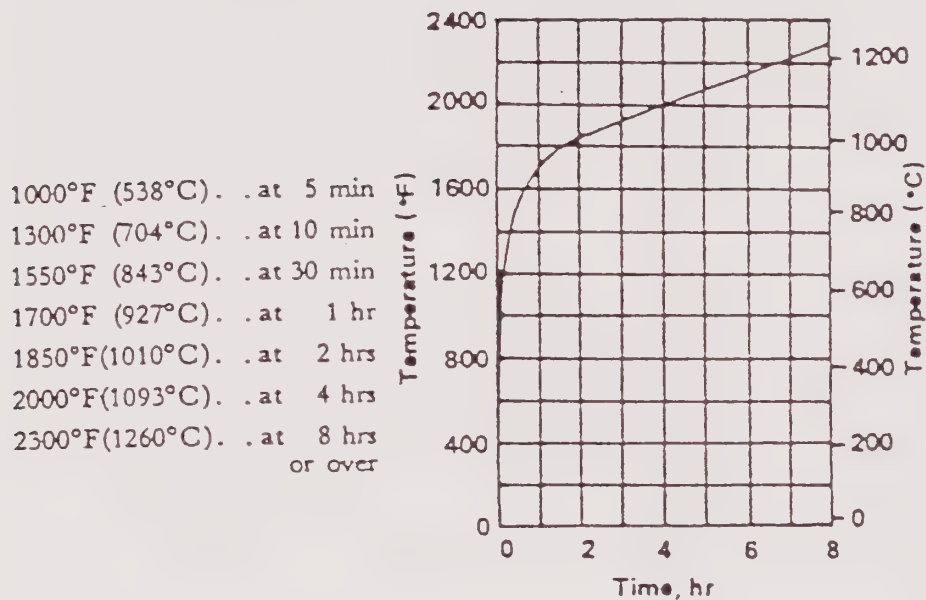
1. Response Time

Five minutes after the outbreak of a structural fire, temperatures reach a level causing significant damage, making lengthy response times a significant fire hazard. Within the first five minutes of a fire, temperatures cause instant combustion of building materials and furnishings, or "flashover", significantly damaging structures and their contents. Buildings outside a five minute response time from a fire station face nearly guaranteed losses in the event of a structural fire, and greater losses than structures within the five minute response time.

The importance of fighting a fire within the first five minutes is illustrated in Figure 2. "The Time-Temperature Curve". This figure points out that within five minutes, structural fires reach 1000 degrees Fahrenheit. These temperatures are high enough to instantly ignite most interior materials; the ignition temperature of wood is 508 degrees, cotton is 410 degrees, and synthetic fiber is 600 degrees Fahrenheit.

At 1000 degrees, thermal radiation feedback from building ceilings and upper walls, heats the contents of the fire area and brings combustibles to their ignition temperature. At this temperature, simultaneous ignition of interior finishing, furniture, and draperies occurs increasing the likelihood of fire spread to other areas, releasing potentially toxic fumes, causing substantial damage to the structure and contents, and threatening adjacent structures. (National Fire Protection Association, "Building Construction and Materials, Section 2-1.1.). Because fires allowed to burn more than five minutes result in significant damage, lengthy response times caused by poor road access, unclear addressing, or distance from a fire station pose significant risks to lives and property.

Figure 2. The Time Temperature Curve



Source: National Fire Protection Agency, Building Construction Materials, 1985.

Many Marin structures lie outside a five minute firefighter response time. A study of fires occurring between 1981 and 1985 in the Marin County, Novato, Inverness, and Alto-Richardson Bay Fire Departments, conducted by the County Planning Department, found that 133 out of 406 fires between 1981 and 1986 in selected fire districts were beyond a five minute response time. The survey also found that fires occurring in areas beyond a five minute response time caused greater damage than fires within the five minute response area.

Over the period studied, 406 commercial and residential fires occurred. Of these, 273 were reached within five minutes of the call for assistance and 133 were beyond the five minute response time. Damage from fires reached within five minutes included a total of \$1,317,535 in property damage and \$399,740 in content damage or an average of \$7,000 per fire. Fires outside the five minute response time caused \$1,614,120 in property damage and \$373,425 in content damage for an average of \$15,000 per fire.

Thus, over a six year period, the 133 out of a total 406 fires which occurred outside the five minute response time caused

greater average and total damage than fires within the five minute response time. These figures clearly demonstrate that fires outside the five minute response time have caused greater damage than those a shorter distance from fire assistance. (Note: a single 2 million dollar commercial building fire in the urban area which occurred in 1986 was not included in the survey results cited above because it was much larger in magnitude and dollar damage than other incidents reported.)

2. Road Access

Lengthy response times in different areas may be caused by distance from a fire station or poor road access. Fire fighters identified poor roads as an important contributor to lengthy response times in the survey of Fire Districts conducted by the County Planning Department. Off-road vehicle and visitor parking on fire or narrow roads also impede public safety vehicle access to residences and rural areas. Fire fighters in the County also noted that in some areas, roads are too narrow and the turning radius inadequate for fire safety vehicles.

3. Water Supply

Water supply availability concerns fire fighters in Marin. According to fire officials in the Tamalpais Fire Protection District, water supply for fighting structural fires may prove inadequate depending on the size of the fire. The 1984 Donald Perry study of the Tamalpais area stated that the water system in the Mill Valley/Tamalpais area had minimal pressure flows making the fire hazards in this area even more serious. Fire officials for the City of San Rafael and Ross Valley also identified the lack of water supply as an important fire hazard in the unincorporated areas they serve.

V. FIRE PROTECTION MEASURES IN MARIN COUNTY

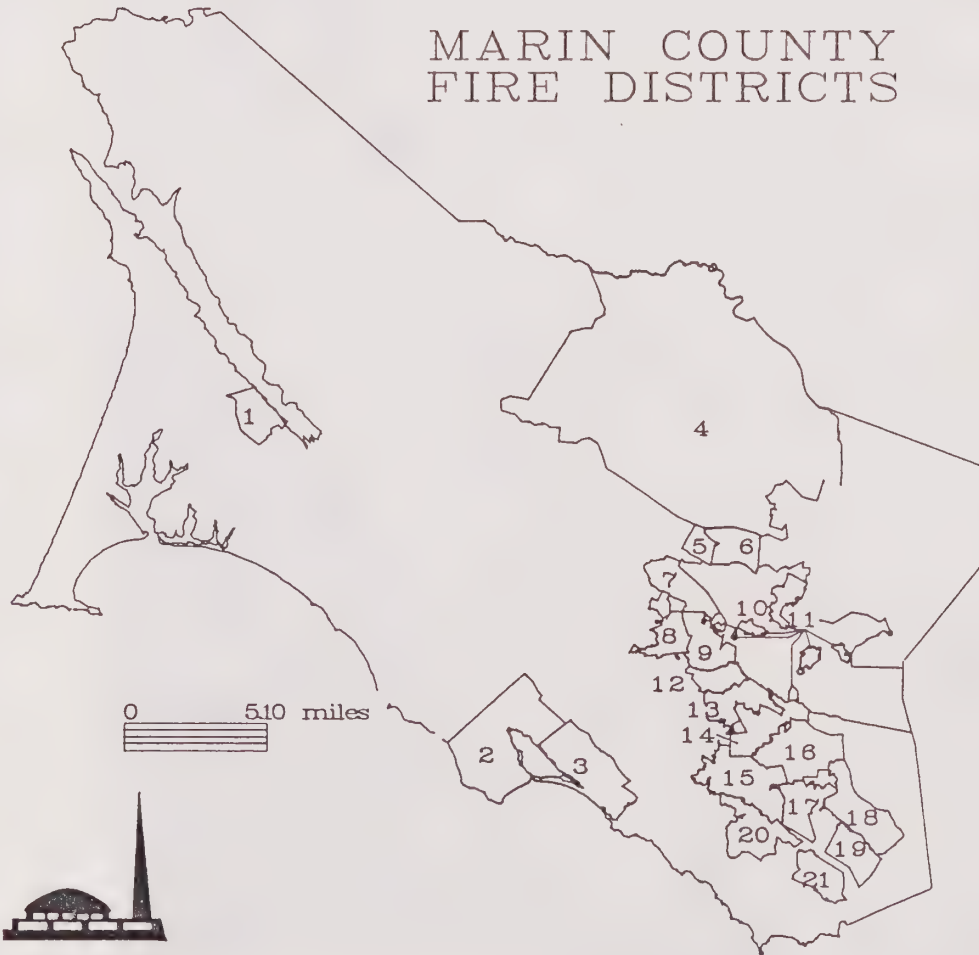
A. Marin County Fire Protection Districts

Fire Protection Districts, Community Service Districts, the County of Marin, and Marin cities all provide fire services to unincorporated Marin communities. The State of California also contracts with the County of Marin to provide fire service for the large portions of the County outside the urban area falling within the State Responsibility Areas. Fire fighting within the State Responsibility Area, shown on Map 2, is the responsibility of the State of California. In Marin County, this area includes most of the inland rural and coastal portions of the County as well as several urban area communities including Homestead Valley, Kentfield, Lucas Valley, Marin City, Marinwood, portions of Santa Venetia, and Tamalpais Valley.

Fire protection service in Marin County includes response to incidents as well as a variety of programs and special regulations designed to prevent fires from occurring. Fire protection activities include public education, landscape management programs, and special construction standards. Several cities and a few fire districts have established fire safety regulations including fire retardant roofing standards, and requirements for automatic sprinklers in residential and commercial buildings beyond a five minute response time. The State of California applies special standards for Class C fire retardant roofing to the Marin State Responsibility Areas and is considering a new series of construction standards for all new and substantially improved structures. A more complete description of fire protection services and special district standards is provided in Appendix A.

MAP 1

MARIN COUNTY FIRE DISTRICTS



- 1 Inverness
- 2 Bollinas
- 3 Stinson Beach
- 4 Novato
- 5 CSA 13
- 6 Marinwood
- 7 Sleepy Hollow
- 8 Fairfax
- 9 San Anselmo
- 10 San Rafael
- 11 CSA 19
- 12 Ross
- 13 Kentfield
- 14 Larkspur
- 15 Mill Valley
- 16 Corte Madera
- 17 Alto-Richardson
- 18 Tiburon
- 19 Belvedere
- 20 Tamalpais
- 21 Sausalito

Marin County Planning Dept. February 1988



B. Construction Standards

1. Uniform Fire Code

The Uniform Fire Code, Marin County Code Title 16, adopts the 1985 edition of the Uniform Building Code recommended by the Western Fire Chiefs Association and the International Conference of Building Officials. In addition to the Uniform Building Code Requirements, this section of the County Code specifies the following building requirements for fire safety:

- a. States that the Chief will designate fire appliances to be installed according to the severity of probable fire.
- b. Requires residential fire alarms for all single and multiple family homes sold or significantly repaired.
- c. Requires permits for outdoor burning.
- d. Prohibits the storage above ground of flammable and combustible liquids unless authorized by Fire Department permit.
- e. All newly constructed buildings must post addresses so that they are visible from the street or road fronting on the property.

2. Uniform Building Code

The Marin County Building Code, Title 19, adopts and makes exceptions to recent editions of the Uniform Building Code for commercial and residential buildings (1985 commercial, 1982 residential). The Title also adopts recent editions of the Mechanical, Housing, Electrical, Plumbing, Pool, and Solar Energy Codes. The Chief Building Inspector enforces the provisions of the building code and cooperates with the County Fire Department in enforcing local ordinances relating to automatic fire alarms and extinguishing equipment, the storage and use of flammable material, and in inspecting burned structures for structural integrity and any hazards which would cause injury.

The County's Building Code specifically establishes building standards to reduce fire hazards in unincorporated Marin in the following areas. The Code:

- a. Defines a hazardous building and "attractive" nuisances which shall be abated; and
- b. Requires building plans to meet fire resistive requirements e.g. resistive materials for exterior walls, common walls and safe egress from upper floors.

3. Fire Protection District Standards

Fire-related building standards for structures in Marin cities, towns and unincorporated areas differ among jurisdictions. Some cities and towns require fire retardant roofing and residential automatic sprinklers through city-adopted ordinances. Building standards not included in local government codes may be suggested by local fire officials in response to individual development applications.

Fire districts in unincorporated Marin comment on discretionary development applications when these are referred by local planning departments. In the case of discretionary permits, conditions suggested by fire officials are usually incorporated into the conditions of approval of the development project. Many Marin fire officials do not review building permit applications which are not discretionary, however, because they do not receive lack the staff to review pending building permit applications. Fire officials who do review building permits are concerned that the fire safety conditions which they recommend do not have the force of law and the application of fire safety requirements is consequently uneven within the County.

The special fire safety construction standards adopted by cities and fire districts in the County fall into three general categories: fire retardant roofing, automatic sprinklers, and land management/weed abatement. Each of these areas of regulation are discussed below.

a. Fire Retardant Roofing

The Uniform Building Code reports the results of independent research on the fire retardant nature of available roofing materials. (UBC Section 3202). Fire retardant roofing materials are classified according to their resistance to fire exposure as follows:

Class A Resists severe exposure. Includes fiberglass, clay, concrete, perlite, tar and gravel, and coated steel.

Class B Resists moderate exposure. Includes coated steel, pressure treated cedar, and tar and gravel.

Class C Resists light exposure. Includes coated steel, pressure treated cedar, tar and gravel, and treated aluminum.

The State of California requires a minimum (as of July 1, 1988) Class C fire retardant roofs in all new construction within the State Responsibility Area. Much of Marin County land outside of

the urban corridor falls within the State Responsibility Area and is subject to these State fire retardant roofing requirements. Map 2, State Responsibility Areas, indicates the areas subject to the Class C minimum roofing requirement.

Several Marin cities require fire retardant roofing as a condition of development approval including: Corte Madera, Larkspur, San Rafael, and Tiburon. While several districts have no authority to impose fire roofing standards many district officials feel that such a requirement is important for fire safety. These districts regularly recommend that fire retardant roofing requirements be incorporated into conditions of approval for development (Inverness, Novato, Ross Valley, Tamalpais).

b. Automatic Sprinklers

Automatic sprinklers for residential and commercial development prevent structural fires from causing significant damage. This can be particularly important in structures beyond a five minute response where significant losses would otherwise occur. Sprinkler systems are estimated to cost \$1.50 per square foot of living area; which could \$3,000.00 to the cost of a 2,000 square foot home.

Yet, declining costs and increased reliability make sprinklers an sensible and popular fire safety device. Insurance carriers often provide discounts to homeowners with sprinklers that can range from 5% to 13% according to the National Fire Protection Association. The UBC allows for reduction in fire restrictive walls when sprinklers are installed. Uniform automatic sprinkler requirements also provide homeowners with the assurance that their property and safety will be protected in the event of a fire, even if they live at some distance from a fire station.

The Marin Fire Chiefs Association unanimously endorsed a uniform county-wide automatic residential sprinkler system requirement for new buildings beyond a five minute response time in 1979. Several Marin cities and towns now require residential sprinklers including Corte Madera, San Rafael, Sausalito, and Tiburon.

Several fire districts in the County regularly recommend sprinklers as conditions of development approval (Alto-Richardson Bay, Inverness, Marin County, Ross Valley, and Tamalpais). Some districts have expressed an interest in Countywide adoption of a sprinkler requirement that would uniformly require these safety devices in new structures.

c. Land Management/Weed Abatement

The proximity of dry vegetation to developed areas poses one of the most significant fire hazards in the County according to fire protection district authorities. Most of the fire protection districts, consequently, conduct special land management/weed abatement education and ground clearance programs to reduce this fire hazard. Educational programs range from elementary school fire awareness to notices encouraging homeowners to reduce dangerous vegetation around their homes. The San Rafael Fire Department goes door to door pointing out brush hazards to homeowners.

Some districts require brush clearance or weed abatement and may levy fines for non-compliance (Marinwood CSD, Mill Valley, Novato, Ross Valley, San Rafael, Tamalpais, and Tiburon). The city of Novato general plan requires all new subdivisions to submit a land management plan which details proposals for reducing brush hazards and incorporating fire resistant landscaping. The Tamalpais and Novato Fire Protection Districts are also exploring the use of controlled burning in areas with decades of flammable vegetation build-up to reduce the threat of a serious wildland fire spreading out of control.

C. Multihazard Plan Guidelines For Fire Disasters

The Marin County Department of Emergency Services is preparing a comprehensive disaster plan for the County of Marin which includes contingency plans for wild fire and urban fire emergencies. The County Board of Supervisors approved the first part of the plan, "Multihazard Plan, Part A" in September of 1986 (Marin County Resolution 86-319, 1986, Marin County Code 2.99). Parts Two and Three of the Multihazard Plan, required disaster operations and responsible agencies, remains to be completed.

The Multihazard Plan addresses Marin County's response to extraordinary emergency situations, and focuses on large-scale disasters which pose major threats to life and property. The plan also outlines emergency conditions, agencies responsible for responding to emergencies, hazard mitigation measures, mutual aid agreements, and checklists for action in the event of an emergency.

Designated Marin County officials activate the plan by declaring a State of Emergency following a disaster. Public officials coordinate emergency response from a central Emergency Operations Center (EOC), located in the County Administration Building.

The Multihazard Plan discusses wildland fires in Appendix A-5.

"Response to Wildfire" outlines actions for officials in the event of a major wildfire including the establishment of an independent command post, evaluation of extent of fire, evacuations, traffic control and transportation of supplies and equipment, requests for mutual aid, emergency public information including evacuation instructions and media announcements, and provisions for return home travel.

Appendix A-6, "Response to Urban Fire", outlines required actions and responsibilities to be taken in the event of a major urban fire, such as maintaining communications with fire officials on-site, evacuating, establishing access and traffic control, determining if a hazardous materials team response is required, requesting mutual aid, informing the public, and providing for re-entry of evacuated areas.

VI. STATUS OF THE 1977 ENVIRONMENTAL HAZARDS ELEMENT

The Fire Hazards policies of the 1977 Environmental Hazards Element have been partially implemented. This section reviews fire hazard policies and the programs which realized them.

Policy C-3.1 The County should undertake a program of identifying and mapping extreme fire hazard areas.

The State of California Department of Forestry studied and ranked Marin County fire hazards in the State Responsibility Area in a 1983 study "Instructions for Zoning Fire Hazard Severity in State Responsibility Areas in California". The study defined fire hazards in all of the Marin State Responsibility Area (SRA) as moderate, requiring at least a class C fire retardant roofing material for all development in the SRA effective 7-1-88. The Tamalpais Fire Protection District with the City of Mill Valley and the Novato Fire District conducted studies of fire hazards in their areas (Perry, 1983, 1984). Studies and maps for the remaining unincorporated has not been completed.

Policy C-3.2 Land development and residential building permit applications should be referred to the County Fire Department or pertinent local fire districts for review and recommendation.

All discretionary permits affecting properties in the County unincorporated areas are transmitted to relevant fire protection districts by the County Planning Department (including design review, use permits, and variances). Authorization for these practices exists in Marin County Code Sections 16 (Fire), 19 (Buildings) 20 (Subdivisions), and 22 (Planned Districts). Building permits are not routinely referred to local fire districts, although a list of pending permits is available for review at the County Administration Building.

The conduct of building permit review is left to the discretion of the individual fire protection districts. Only the Marin County Fire Protection District (located in the same office building as the Land Development Division of the Department of Public Works where building permits are processed for the County) regularly reviews building permits within its jurisdiction because they have ready access to building permit records kept in the County Administration Building. Most of the other fire protection districts serving unincorporated Marin do not have the same easy access and are not able to consistently review permit applications. The lack of a convenient system for fire district review of building permits generates confusion between land development and planning staff and the fire districts, resulting in new residential development which has not been reviewed in

advance by the relevant fire authorities.

Policy C-3.3 New subdivisions and land divisions in areas identified as having extreme fire hazards should only be allowed where it is determined that adequate on or off site fire suppression water supply is or can be made available. For residential subdivisions access should be provided from more than one source where feasible. Fire trails and fuel breaks should be required to be constructed where necessary as a mitigation of excessive risk if at all possible. If development is to occur in extreme fire hazard areas, fire resistant materials, clearances from structures, and landscaping with fire resistant plants should be required.

The County does not have codified requirements for high fire hazard areas beyond basic fire and building code standards. Fire Marshalls for the Fire Districts serving the County may recommend construction standards in fire hazardous areas, but the County does not consistently withhold permits based on lack of compliance with a fire safety recommendation.

Policy C-3.4 The Marin County Fire Department, or other local fire protection agencies in concert with the Division of Forestry and the National Park Service, shall encourage and promote the maintenance of existing fuel breaks and emergency access routes for effective fire suppression.

While normal operational coordination exists for the maintenance of fuel breaks and fire suppression, no specific procedures exist in this area.

Policy C-3.5 The Board of Supervisors and the appropriate County agencies and all other agencies having fire protection responsibilities should continue to implement the latest Uniform Fire Code.

Most districts in the County apply the most recent Uniform Fire Code Standards.

V. PROPOSED AMENDMENTS TO THE ENVIRONMENTAL HAZARDS ELEMENT

The following section indicates proposed policy modifications for the Environmental Hazards Element update. Policies from the 1977 Element remaining in the proposed policy statement appear in bold text. Newly proposed policies and implementation measures appear as underlined text.

The policies are labelled with the abbreviation of the Environmental Hazards Element (EH) and the number of that policy within the element. Each implementation measure relates to a specific policy and is identified by the initial "I". Lower case letters indicate different implementation measures for each policy.

EH-13 **The County should undertake a program of identifying and mapping extreme fire hazard areas. (Existing policy).**

EH-13-Ia The County Planning Department in coordination with the County Fire Marshall should map known fire hazard areas subject to wildland fire risk and make these maps available to planners and the public for use in project review where appropriate building standards may be applied.

EH-13-Ib The County Planning and Building Departments in consultation with the County Fire Marshall and Fire District Officials serving the unincorporated County should identify and map areas beyond a five minute response time and consider these as hazardous areas subject to automatic sprinkler requirements.

EH-14 **Land development and residential building permit applications should be referred to the County Fire Department or pertinent local fire district for review and recommendation. (Existing policy)**

EH-14-Ia The County Planning Department should collaborate with the Department of Public Works and Fire Districts serving the unincorporated County to develop building standards for fire safety in lieu of a permit referral system particularly for the standard building permit where no Planning permits are required. A revised code would apply stricter standards than some districts require but provide a baseline of building fire safety for all districts in the unincorporated area.

EH-14-Ib Recommendations routinely made by fire authorities

on discretionary Planning permits should be included as conditions of approval of those permits.

- EH-14-Ic Requirements for referrals to County fire officials should be specified in the County Code.
- EH-15 New subdivisions and land divisions in areas identified as having extreme fire hazards should only be allowed where it is determined that adequate on or off site fire suppression water supply is or can be made available. For residential subdivisions access should be provided from more than one source where feasible. Fire trails and fuel breaks should be required to be constructed where necessary as a mitigation of excessive risk if at all possible. If development is to occur in extreme fire hazard areas, fire resistant materials, clearances from structures, and landscaping with fire resistant plants should be required. (Existing policy)
- EH-15-Ia Direct authorization to implement the above policies is found in County Code Titles 16 (Fire), 20.20 (Subdivisions), and 22.47 (Planned Districts-Specific Regulations). Other Related authorization is provided for by Marin County Code Title 19 (Buildings).
- EH-15-Ib Evaluate the adequacy of standards for water supply and road access to subdivisions in the County Building, Subdivision and Zoning Codes (Marin County Code Titles 20 and 22).
- EH-15-Ic Amend the Marin County Code to incorporate a requirement for Class-C fire retardant roofing in all County unincorporated areas to bring all portions of the County into conformance with fire retardant roofing standards presently in place for State Responsibility Areas in Marin.
- EH-15-Id Amend the Marin County Code to establish uniform standards for clearance from structures, landscaping, and fire resistant building materials (particularly pole construction), for all new construction in fire hazard areas.
- EH-15-Ie Amend the Marin County Code to provide for referrals of all development and building permit applications to fire officials in affected areas.

- EH-16 The Marin County Fire Department or other local fire protection agencies in concert with the Marin County Open Space District, the State Division of Forestry and the National Park Service, should encourage and promote the maintenance of existing fuel breaks and emergency access routes for effective fire suppression. (Existing policy)
- EH-17 The Board of Supervisors and the appropriate County agencies and all other agencies having fire protection responsibilities should continue to implement the latest Uniform Fire Code. (Existing policy)
- EH-17-Ia The Marin County Code should be periodically reviewed to insure conformance with the latest Uniform Codes.
- EH-18 Response time in excess of five minutes creates a risk of injury to life and property in the event of a structural fires. (Existing policy)
- EH-18-Ia Amend the Marin County Code to establish that all structures beyond a five minute response time be protected by a fully automatic sprinkler system approved the County where feasible.
- EH-19 The County should plan for the systematic and environmentally sound reduction of hazardous vegetation throughout the County to reduce the unnatural buildup of old and hazardous vegetation created by effective fire suppression activities over the last 40 years. (Existing policy)
- EH-19-Ia Support plans for reducing the buildup of flammable vegetation through controlled burning in the Tamalpais area being developed by the County Open Space District, the Tamalpais Fire Protection District, and the Novato Fire Protection District.
- EH-20 Implement fire safety standards developed by the State of California for the State Responsibility Areas in a uniform manner to insure comparable safety standards for all new construction in the County and to simplify the development review process.
- EH-20-Ia Revise the Marin County Code to bring it into conformance with State Responsibility Area construction and fire safety standards.

APPENDIX A. SURVEY OF MARIN COUNTY FIRE PROTECTION DISTRICTS

During the summer of 1987, Marin County Planners conducted a survey of Marin County Fire Protection Districts and incorporated fire departments. Each district provides fire service to Marin homes and businesses including fire fighting, public education to prevent fires, identification of fire hazards, and programs designed to reduce fire hazards. The activities of each fire district in Marin County are described below.

1. Alto-Richardson Bay Fire Protection District

The Alto-Richardson Bay Fire Protection District serves the unincorporated communities of the Richardson Bay area. The District works with homeowners associations to do an annual earthquake day, teach CPR, and sends flyers to residents with fire safety tips several times each year, and conducts "learn not to burn" and fire drill programs with the local schools. The district is presently considering a sprinkler requirement for all new structures in the district to reduce the level of damage caused by fire outbreak before the arrival of fire fighters, particularly for areas outside a five minute response time.

2. Bolinas Fire Protection District

The Bolinas Fire Protection District is a volunteer District serving the unincorporated community of Bolinas. The District makes fire safety presentations to students at Bolinas School twice a year, sponsors a fire safety contest for children, and places notices in local papers during high hazard seasons. The District considers the downtown area to be particularly hazardous because it contains a number of old wood frame buildings located close to one another. The District is beginning to develop a series of pre-fire plans for each commercial building to help prevent serious fires.

3. Corte Madera Fire Department

The Corte Madera Fire Department serves the Town of Corte Madera and a small unincorporated portion of Lucky Drive. The Department mails fire safety information to the public and conducts a door-to-door fire safety educational program for homes in wildland areas. Wildland fires pose the most significant fire hazard in Corte Madera, where access is poor and many homes are built into the trees and brush. Corte Madera requires fire retardant roofing, automatic sprinkling systems for buildings beyond a five minute response time, and a variety of other building standards designed to provide maximum protection against the risk of fire losses.

4. Inverness Fire Department

The Inverness Fire Department, composed of volunteers, serves unincorporated Inverness. The department distributes public information about fire safety, and conducts courses in CPR and fire safety for children. The Department makes recommendations for improving fire safety in new construction to the County planning and building departments, occasionally recommending fire retardant roofing and sprinklers.

5. Kentfield (no survey)

6. Larkspur Fire Department

The Larkspur Fire Department serves the city of Larkspur. The Department conducts home safety and grade school "learn not to burn" courses and conducts home safety inspections upon request. Larkspur adopted residential smoke detector and fire retardant roof requirements to reduce the risks associated with fires in the home.

7. Marin County Fire Department

The County Fire Department serves unincorporated areas not served by other Fire Authorities including portions of Mt. Tamalpais, portions of Big Rock Ridge, and the entire State Responsibility Area for Marin County. The Department has a single staff person responsible for fire prevention programs which include presentations for school children and homeowners living in wildland areas.

Fire hazards reported by the Department include the buildup of vegetation in much of the County which poses a serious fire threat to nearby developed areas. New construction activity in some areas may strain water supplies in the event of a fire. House addressing systems in portions of the County are unclear and confusing for fire fighters.

The Department also highlighted the lack of consistency and coordination between the fire districts serving unincorporated Marin, in particular the inability of fire officials in districts serving the unincorporated areas to withhold development approval for fire safety reasons or to enforce the fire construction standards they believe are necessary to protect homes in their areas.

As an example of the inconsistencies between regulations, the State of California will require fire retardant roofing (Class C or better) in all new development occurring within the State

Responsibility Area protected by the County Fire Department. No such requirement exists, however, for the other unincorporated communities outside the State Responsibility Area, although fire conditions may be identical or more severe in the unincorporated areas where no requirements apply.

8. Marinwood and County Service Area 13

The Marinwood Community Service District provides fire protection to the Marinwood/Lucas Valley area. The District conducts public education classes in CPR, First Aid and fire safety. The district also works with several other districts on a fire safety day for the county. Fire problems identified in the District include the presence of flammable brush and grasses near developed areas and the number of homes with wood shake roofs. The District requires fire breaks behind homes and conducts weed abatement/roof cleaning campaigns including a letter from the fire chief distributed to all homes to encourage residents to reduce fire hazards.

9. Mill Valley Fire Department

The Mill Valley Fire Department serves the City of Mill Valley. The Department makes "learn not to burn" presentations to public schools and coordinates a fire prevention week to educate the public about fire safety. The Department identified most canyon areas as particularly hazardous areas due to poor road access, steep slopes, and long response times to reach many homes. The Department also cited proximity to the Golden Gate National Recreation Area, with its large expanses of thick vegetation as posing a fire hazard to Mill Valley residents. The Department conducts a weed abatement program in order to control the proliferation of dangerous vegetation which increases fire risk in the area.

10. Novato Fire Protection District

The Novato Fire Protection District provides fire service to the City of Novato and nearby unincorporated communities. Novato provides fire safety education for residents through film and video presentations made to groups within the district several times each year. Novato also engages in controlled burning of wildland areas to reduce the amount of fuel buildup in open areas which increases the risk of fire spread and damage. The District requires large developments within their jurisdiction to remove dead vegetation periodically. District personnel canvass hill and canyon areas each year urging residents to remove weeds, brush and tree overhangs from around their homes.

Conditions concerning the District include the buildup of dead vegetation in the wildland areas adjacent to residential communities. The District would like the County to consider a policy to ban wood roofing in high fire hazard areas similar to the requirement for fire retardant roofing which now applies to all property within the State Responsibility Area.

11. Ross Fire Department

The City of Ross Fire Department serves incorporated Ross. They conduct grade school fire safety courses. The Department has identified the wildland interface and the potential for a hazardous materials spill on Sir Francis Drake as the most significant fire hazards in the area. The Department relies on Standard Oil in Richmond for hazardous materials fire fighting equipment.

12. Ross Valley Fire Authority (Includes Sleepy Hollow)

The Ross Valley Fire Authority provides service to the community of Sleepy Hollow and nearby unincorporated areas. The Authority conducts informational programs for all homes bordering open space areas and works with the public schools on their "learn not to burn" program. The Authority conducts an annual grass and brush clearance program for homes near wildland areas.

The fire hazards within the Ross Valley area include the growth of combustible vegetation near improved areas, very lengthy response times to fires in many areas and the blockage of fire roads by off-road vehicles. In particular, the lack of uniform requirements for fire retardant roofing and residential sprinklers in residential areas located at a distance from a fire station pose problems.

13. San Rafael Fire Department

The City of San Rafael Fire Department serves the City of San Rafael and unincorporated areas around the city. The Department conducts public education programs, including joint sponsorship of Countywide Fire Prevention Week, and a public education presentation delivered several times throughout the year.

The City identifies most of the County unincorporated areas served by the San Rafael Fire Department as high hazard areas due to the interface between developed areas and hazardous brush-filled wildlands, and the lack of adequate water supply. In order to mitigate these hazards, the City of San Rafael requires fire resistant roofing, vegetation control, standards for road access to structures including road grades and turning radii, the

upgrading of water supply, and the installation of automatic smoke alarms and sprinklers.

14. Sausalito Fire Department

The Sausalito Fire Department serves the City of Sausalito. The Department's public education projects include earthquake preparation, CPR, and home safety presentations. Narrow streets pose the most significant fire hazard, which the district is combatting by purchasing smaller, European pump trucks.

Another problem identified by the district is the lack of uniform automatic sprinkler system requirements in the County, and the penalizing fee system enforced by the Marin Municipal Water District which discourages the voluntary use of sprinklers. MMWD charges a standby water supply fee for buildings with sprinklers, a fee which does not represent the amount of water saved by using sprinklers to control fire spread.

15. Tamalpais Fire Protection District

The Tamalpais Fire Protection District serves unincorporated areas near the City of Mill Valley including Tamalpais and Homestead Valley. The District's education programs include fire safety classes, and notices in local papers about the extent of fire hazards throughout the year.

The District identified the potential for wildland fires due to poor access to many developed areas, poor water availability, and the proximity of brush and vegetation to homes as a serious fire hazard. These conditions are exacerbated by the parking patterns along many of the most narrow streets where double parking or illegal parking is common and prevents safety vehicle access.

The Department engages in weed abatement, posts no parking signs, and encourages the County to require fire retardant roofing in the Tamalpais area. New developments approved by the County, however, lack adequate road access for safety vehicles and do not provide fire retardant roofing thereby increasing risks of loss for these new developments.

16. Tiburon Fire Protection District

The Tiburon Fire Protection District provides fire service to the Town of Tiburon and unincorporated communities on the Tiburon peninsula. The District coordinates with the Corte Madera and Alto Richardson districts for fire service in the areas near Highway 101. The District conducts weed abatement programs every spring, works with homeowner groups on fire safety, conducts home

safety inspection programs on request, and conducts regular inspections of all structures other than single family homes. The District's educational programs include "learn not to burn" activities in the schools, earthquake safety drills, and CPR and First Aid courses.

Fire hazards identified by the district include poor access to many areas and hazardous structures along Tiburon's Main Street. The District addresses these conditions by requiring sprinklers in all new construction within the district and the installation of sprinklers in existing structures when property is sold. Tiburon also requires fire retardant roofing for new construction.

APPENDIX B. REFERENCES

California State Department of Forestry. Fire Safety Guides, May 1980.

State of California. California Government Code, Sections 65302, 65303, 65451, 1987.

State of California. California Health and Safety Code, Section 13108, 1987.

Committee for Firesafe Roofing. The ABC's of Fire Retardant Roofs, 1981. County of Marin. Marin County Code, 1987.

Jacobs, Cole, McBride. "Fire History and Perpetuation of Natural Coast Redwood Ecosystems". Journal of Forestry, Vol. 83, No. 8, August 1985.

Marin County Department of Emergency Services. Multihazard Plan, 1986.

Marin County Fire Department. "Partial History of the Watershed Area of Tamalpais", 1986. Marin County Open Space District. "Controlled Burns on District Open Space Lands", November 4, 1986.

Marin County Planning Department. Survey of Marin County Fire Districts, 1987.

National Fire Protection Agency, Building Construction and Materials, Section 251-6, 1985.

National Foundation for Environmental Safety. Newsletter, Vol. 3, No. 4, October 1986.

Donald Perry. An Assessment of Wildland Fire Potential in the City of Mill Valley and the Tamalpais Fire Protection District, City of Mill Valley and the Tamalpais Fire Protection District, 1984.

Donald Perry. Fuels, Environmental, and Fire Behavior Associated with the Wildland Urban Interface of Novato, CA., Novato Fire Protection District, 1983.

State of California Department of Forestry, Telephone Survey, 1987.

State of California Resources Agency. Instructions for Zoning Fire Hazards Severity in State - Responsibility Areas in California, 1983.

Sunset Magazine. Protecting Your Home Against Brushfire, Lane Publishing Co., September 1983.

Tiburon Fire Protection District. "Fire Safe Guidelines", 1986.

U. S. Department of the Interior, National Park Service and the Golden Gate National Recreation Area. Fire Management, 1985.

The Wall Street Journal. Home Sprinklers Stir Debate As More Cities Require Them. Wednesday, August 12, 1987.

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Appendix C. List of People and Agencies Contacted

Douglas Archer, Larkspur Fire Department.
Rosemary Bliss, Fire Marshall, Tiburon Fire Protection District.
Steven Bogel, Sausalito Fire Department.
Linda Brandelius, Corte Madera Fire Prevention and Public Education Division.
Fran Brigman, Open Space Planner, Marin County Openspace District
Robert Burns, Committee for Firesafe Roofing.
Ralph Camiccia, Fire Chief, Bolinas Fire Protection District.
Jeff Davidson, Mill Valley Fire Department.
Tom Elliot, Fire Marshall, Novato Fire Protection District.
Jim Fox, Assistant Chief, Inverness Public Utility District.
John Lando, Fire Marshall, Kentfield Fire Protection District.
Dan Lang, Fire Prevention Engineer, California Department of Forestry.
Bill Lellis, Larkspur Fire Department.
Larry Martinez, Captain, Tamalpais Fire Protection District.
Michael Meszaros, Fire Chief, Inverness Public Utility District.
Rick Mollenkoph, Fire Chief, Ross Valley Fire Authority.
Jay Neuhaus, Fire Chief, Marinwood and CSA 13.
Keith Schoenthal, Fire Marshall, San Rafael Fire Department.
Bruce Selfridge, Captain, Ross Public Safety Department.
Richard Shell, California Department of Forestry.
Michael Shields, Fire Marshall, Marin County Fire Department.
Alta Widner, Staff Analyst, California State Department of Forestry.
Dennis Woolheater, Captain, Alto Richardson Bay Fire Protection District.



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